THE ENGINEER

SEPTEMBER 26, 1952

The Machine Tool Industry

IN a speech at a luncheon given on Thursday of last week by the exhibitors at the International Machine Tool Exhibition at Olympia, the Minister of Supply, Mr. Duncan Sandys, said that Britain had been building up a very fine machine tool industry of which it had every reason to be proud. The high quality of the machine tools this country was now making was proved by the large volume of orders from overseas. British makers, he said, were now exporting at least a third more machines than before the war and the export figures would have been very much higher had it not been necessary to reserve large numbers of machines for this country's defence programme. Mr. Sandys expressed the appreciation of the Ministry of Supply to the machine tool industry for the way it had responded to the many and heavy calls made upon it by the Ministry. He also thanked manufacturers from overseas for their work in supplying urgently needed machines, about half of which had now been received. Mr. Sandys pointed out that, although rearmament would continue to absorb an appreciable part of the nation's industrial output for several years to come, with the exception of certain special machines, the industry would have largely completed its task by the end of this year. It would then be able to devote more of its resources to normal commercial business, and in this connection it was clear from the variety of exhibits that designers had been looking ahead. The world's ability to maintain and improve the living standards of its growing population largely depended upon increased production of every kind and for that reason, the Minister said, machine tools had a vital part to play. He considered that we are on the threshold of great advances in machine tool design and it might well be that these developments in the course of the next ten years would open up possibilities of industrial productivity undreamed of to-day. In a brief reply to the Minister's speech, Mr. R. W. Asquith said that it was essential for this country to have a strong, progressive machine tool industry, and he hoped that the present sincerity that the Government expressed for its well-being would continue. The industry would probably need the promised co-operation of the Government, as competition was building up from foreign countries to which considerable financial assistance had been given to assist in industrial recovery following the war.

Flame-Radiation Research

THE seventh annual report of the Nuffield Foundation has been published this week. It covers the year ended March 31, 1952, and surveys the work of the many research projects which have been assisted directly and indirectly by the Foundation. In the chapter dealing with "Miscellaneous Projects" reference is made to the work of the British committee for flame-radiation research, to which the Foundation has offered a grant of up to £650. This committee operates under the chairmanship of Professor O. A. Saunders, and the grant from the Nuffield Foundation was offered to assist the committee to send a physicist to Stockholm for a year to work on flame-radiation research. The report comments on the importance of the study to all kinds of industries, pointing out that special plant for fundamental research is expensive to construct and maintain. A private international scheme has been devised so that work on flame-radiation can be planned and prosecuted co-operatively under a joint committee appointed by British, Dutch, French and Swedish committees. Two special plants, representing the extremes of re-radiation by the walls, are at the service of this international research; one in the Royal Netherlands Steelworks, at Ijmuiden, where an insulated hot-wall furnace is used, and one at the Stockholm Technical College in Sweden, where there is a water-cooled plant with heat-absorbing walls. It may be recalled that an account of the work on flame-radiation research being carried out at Ijmuiden was published in THE ENGINEER of June 20, 1952.

Report on Easington Colliery Explosion

THE Ministry of Fuel and Power has issued this week the report of an inquiry conducted by Mr. H. C. W. Roberts, H.M. Chief Inspector of Mines, into the causes of the explosion at Easington Colliery, Co. Durham, on May 29, 1951. The explosion spread through 16,000 yards of roadway, causing the deaths of eighty-one men. In addition, two men died during the rescue operations. At the inquiry, seventy-five witnesses were examined, and the evidence showed that fire-damp was ignited when the picks of a coal cutting machine operating on a retreating longwall face struck pyrites. The report says that, although electricity was widely used, the evidence revealed that it was not the means of ignition. Some damage and defects were discovered in the electrical plant, but, the report notes, either they had been caused by the explosion itself or they were in such a position that they could not have given rise to the explosion. The report surveys very thoroughly the causes and course of the explosion, and the Chief Inspector has concluded that the main issue of fire-damp was from an accumulation in large cavities in the waste behind the longwall face, and that it was "forced out during a roof weight." He goes on to say in his report that due consideration was not given to the risk of fire-damp accumulation and of roof weight when deciding on the method of work, that the explosion was continued by coal dust derived mainly from conveyor belts and structures, and that there were defects in the system of dust sampling and in the measures taken to prevent, suppress and treat coal dust. Among the recommendations made in the report is one which says that wherever coal cutters are in use or are to be used, a survey should be made for the purpose of selecting a cutting horizon, as far as practicable, clear of any material from which sparks may be struck. It is also urged that everything possible should be done to accelerate progress in the direction of preventing the formation of dust and of suppressing such dust as is unavoidably produced as close to the point of production as possible. The Chief Inspector ends his report by saying that the recommendations on which prompt action is possible have been discussed with the National Coal Board and that appropriate action has been initiated.

Institute of Marine Engineers

ON Tuesday of last week Lord Howard de Walden delivered his presidential address to the Institute of Marine Engineers and mentioned that engineering invention touches every part of a ship so that the marine engineer is a vital factor in the national economy. He recalled the achievements enabling heavy fuel to be burned in diesel engines, the advent of the gas turbine as a propulsion unit and gave a thought to the possibilities of atomic engines. Referring to the work of the British Shipbuilding Research Association and Pametrada, he said that testing developments would help to avoid mistakes which eventually were borne by the shipowner. The shipowner wants reliability and durability and the president went on to discuss the need for increased speed and carrying capacity in order to reduce time at sea in these days of high running costs. Returning to the question of reliability, Lord Howard de Walden doubted the wisdom of applying one high powered engine to one shaft and advocated the use of at least two engines, while suggesting that slower propeller speeds would help to avoid shaft failure. Another point raised regarding the large direct-coupled engine was the difficulty in running dock trials and he suggested the fitting of a disconnecting arrangement between engine and propeller. After remarking upon the work of the Institute in training marine engineers and the need for further improvement in service conditions in the engine-room, the president deplored the disproportionate time spent by a ship in port with its effect of reducing the capacity of the merchant fleet and of increasing the cost of consumer goods. He emphasised the need to speed up cargo handling and thought that with the advances made in mechanical engineering some improvement could be effected upon the present system of handling cargo by derricks and winches in the union system. The president suggested that some attention should be directed to the development of an efficient crane and felt that there was a need for a safe topping arrangement for use with existing cargo gear.

Railway Accidents in 1951

THE report has now been issued on the accidents which occurred in the operation of the railways of Great Britain during the year 1951. The number of train accidents reported during the year rose to 1208, as compared with 1156 in the previous year, and in these accidents there were 1006 casualties. In the fourteen fatal train accidents forty-three passengers, four railway servants and eight other persons, who were occupants of road vehicles at level crossings, were killed. Of the total fatalities, thirty-eight were the result of three serious accidents—the derailment at Doncaster, that at Weedon and the collision at Ford. In movement accidents fifty-four passengers lost their lives as a result of misadventure, carelessness or misconduct, and there were 154 fatalities to railway servants. An analysis of the primary causes of the 1280 train accidents shows that human failure on the part of the operating staff accounted for 559 accidents, technical defects of one kind or another for 193 accidents, and 528 accidents were caused by collisions with road vehicles, fires on trains, opening of doors with trains in motion, &c. The increase in the number of accidents compared with the steady decline shown in the three previous years is discussed in the conclusion to the report. It is pointed out that in the first half of 1951 the railways were faced with a combination of operating difficulties which was unprecedented in time of peace. The shortage of staff to handle the growing volume of freight traffic remained acute and was aggravated by an unusual amount of sickness, the weather was bad, and the shortage of coal resulted in serious congestion. Shortage of raw materials and technical staff were also felt increasingly during the year, and measures to improve efficiency and safety, including signalling modernisation, again had to be deferred. It is pointed out, however, that with the success of the special measures taken to ensure the free flow of traffic in the winter of 1951–52, which were helped by good weather and some easement of the staff position, the railways are now in better heart.

The International Machine Tool Exhibition at Olympia

No. I

THE International Machine Tool Exhibition, which opened at Olympia on Wednesday, September 17th, will remain open until Saturday, October 4th. With our issues of September 12th and 19th we published Supplements describing some of the many new and interesting machines exhibited by British and overseas manufacturers. In this article descriptions are given of a further selection of the machines and equipment exhibited.

Charles Churchill and Co., Ltd.

A group of bar and chucking automatics, capstans and automatic lathes of British, American and Continental manufacture is to be seen upon the main stand of Charles Churchill and Co., Ltd., South Yardley, Birmingham, and a wide selection of the small tools handled by the firm have been arranged on one of the gallery stands.

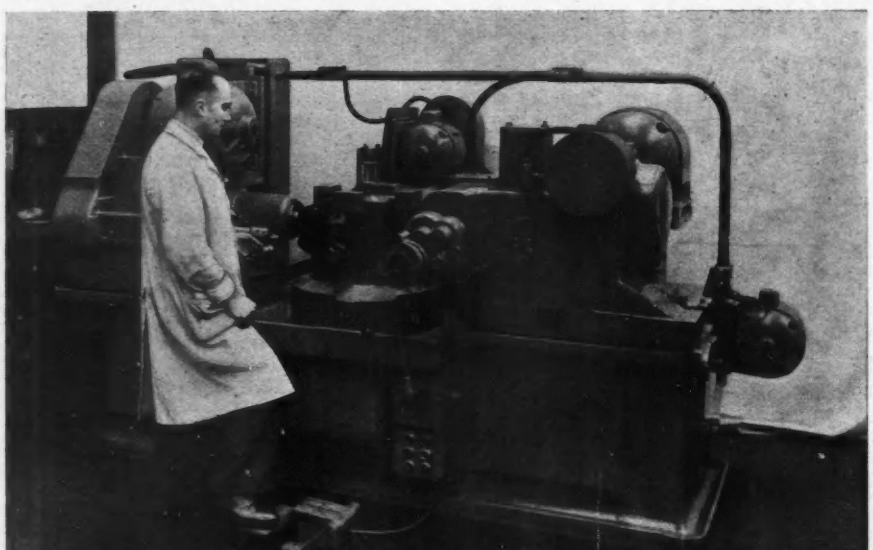


Fig. 1—Multiple-Spindle Chucking Automatic—Churchill

One of the automatics is the Goss and Dé Leeuw multi-spindle chucking machine shown in Fig. 1. This machine is primarily intended for boring, turning, facing and screwing operations on components carried in chucks mounted on a central indexing turret. The machine has three slide-mounted spindle heads, one on each side of the indexing turret and one at the rear. The two side heads each have three spindles and the rear head one spindle. In one side head the three spindles are designed to take boring, turning, facing, drilling, &c., tools. In the opposite head there are three tapping spindles, one in line with the axis of the machine and one at right angles each side.

Each head is driven by an independent motor, and through pulleys and gearing a range of spindle speeds up to 3000 r.p.m. is available. In the screwing head the spindles with their taps or dies are fed into the work by lead screws, and each lead screw is always in engagement with a lead screw nut. If required an extra lead screw can be fitted to each spindle so that two threads of different pitches can be machined simultaneously.

The "Vertimax" vertical, twin-tool slide, chucking production lathe (Fig. 2) is a machine which also represents a departure from usual construction and layout. It is designed to swing work up to 15in diameter, and its vertical spindle can have one of four ten-step speed ranges from 103 to 360 r.p.m., to 270 to 947 r.p.m. The maximum distance from the spindle face to the bottom of a slide set in the horizontal position is 13½in, and when the slides are arranged vertically they can be set up to 12in apart. Each slide has a travel of 5in.

The slides, which can be swivelled through more than 120 deg. from below horizontal to beyond the vertical position, are complete units with their hydraulic feed mechanisms. These slides, besides being made to swivel, have an eccentric mounting and the arms carrying them can be moved radially and horizontally so that the tools can be quickly and easily set in relation to the workpiece.

A 12in by 33in Churchill-Fay automatic lathe is also to be seen on this stand. This universal multiple-tool machine can be equipped with one or more carriages or tool carrying members, and one or more back arms or facing heads can be fitted to face or form shoulder lengths or diameters. Their tool carriages are mounted on ground steel bars and all tool movements are effected by cams and formers.

Lumsden Machine Company, Ltd.

The Lumsden Machine Company, Ltd., of Hawks Road, Gateshead, is showing only one machine, a vertical-spindle, rotary-table continuous grinding machine with two spindles. This machine is designed for the continuous grinding of components mounted on jigs on a rotating table, which carries them through the grinding stages and back again to a loading station at the front of the machine. The grinding wheels of the two spindles can be arranged at different levels for workpieces carrying too much metal to be ground off in one pass with a single wheel. An electronically operated sizing device automatically feeds the wheels down to compensate for wear, and the feed box gives a wide range of adjustment for this electronic control.

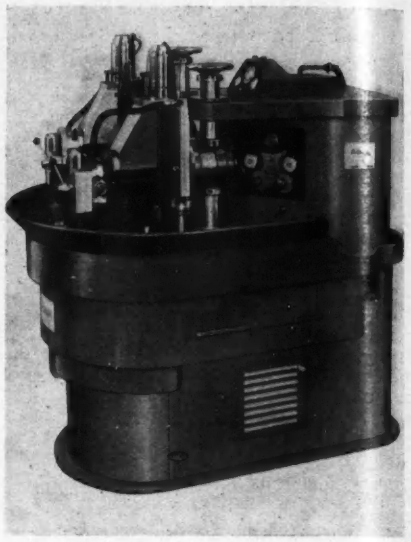


Fig. 2—Vertical Chucking Lathe—Churchill

The spindles and drive are of the firm's standard design for this kind of heavy machine, and the table is driven by an independent motor through worm reduction gearing.

Holbrook Machine Tool Company, Ltd.

The group of toolroom lathes which is exhibited by the Holbrook Machine Tool Company, Ltd., 44–48, Martin Street, London, E.15, includes a recently introduced lathe having a swing of 30in over the bed and taking 72in between centres. It is supplied in one form as a standard machine with internal slide and taper turning equipment, and a top slide of normal design with a square turret. In another form it has no internal slide or taper turning equipment,

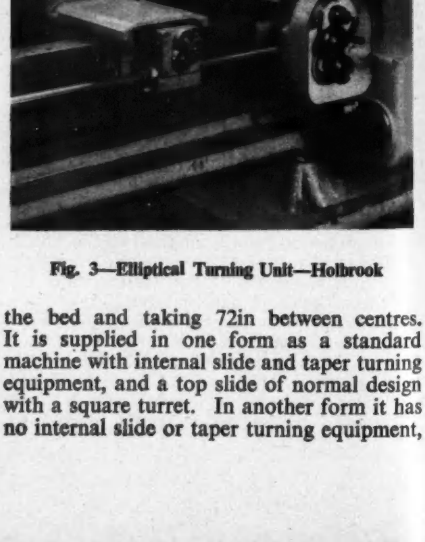


Fig. 3—Elliptical Turning Unit—Holbrook

but has power feed to the top slide, incorporating a clutch to allow hand setting of the tool. With this arrangement, Metropolitan-Vickers electronic profile turning equipment can be fitted if required.

These machines have dial feed changes operated by hydraulic mechanism through which twenty-four spindle speeds from 3½ to 700 r.p.m. are made available in both forward and reverse. A quick-change gearbox provides eighty changes, through a dial control, from 1 to 30 T.P.I., and a feed range of 0·003in to 1·5in per revolution.

One of the firm's " B 21 " toolroom lathes, which swings 22in over the bed and 48in between centres, is fitted with the elliptical turning unit shown in Fig. 3. With this unit, which incorporates two distinct drives, both straight and taper elliptical shapes can be turned.

The work is rotated by the main spindle of the machine through a special coupling which allows the work to rotate off centre. The work-carrying unit is mounted, as can be seen, on a transverse slide actuated by a drive taken through the apron and out to a gearbox at the rear of the lathe carriage. This drive is transmitted through a shaft to a set of change gears controlling the movement of the slide, and thus the variable " offset " movement giving the varying difference of major and minor axes for the work. The gearbox, mounted on the rear of the carriage determines the direction of the offset travel and provides a neutral position so that the work can be set, by means of a cranked handle, before machining starts. The unit can be set for turning straight elliptical work, work with varying major and minor axes and taper work of conic elliptical shape.

For producing taper work of elliptical form having varying difference of axes the power-operated top slide of the machine is used in addition to the normal elliptical motion. Change gears are incorporated to vary the " offset " distance in relation to the taper and the mechanism provides for a 2in maximum offset distance and 8in travel of the tool.

The universal relieving lathe exhibited (Fig. 4) has 11in high centres and takes work up to 33in long between centres. Its headstock is driven by a directly mounted flange motor through disc clutches and its twelve spindle speeds from 3 to 150 r.p.m. are available in both directions. The machine has three separate sets of change gears—screwcutting and fluting housed on the left of the headstock, and compensating gears for spiral relief purposes at the rear of the machine. A range of spiral flutes from 3in to 350in lead is available and from 1 to 30 reliefs. A synchronising differential incorporated in the drive enables the operator to adjust the relative position of the tool to the flute whilst the machine is running through handwheels at the front and the rear of the machine.

The relieving slide of the machine is mounted on anti-friction bearings to ensure a sensitive response to the centrally disposed cam and an adjustable cam damper prevents any undue liveliness. When the carriage is being returned by power a single-toothed ratchet disengages the drive and the cam remains stationary. A profile forming equipment can be bolted to this relieving slide, and cross slides which carry the former run on flat ways with rollers to take the thrust of the stylus. For hob grinding purposes a range of special grinding heads is available.

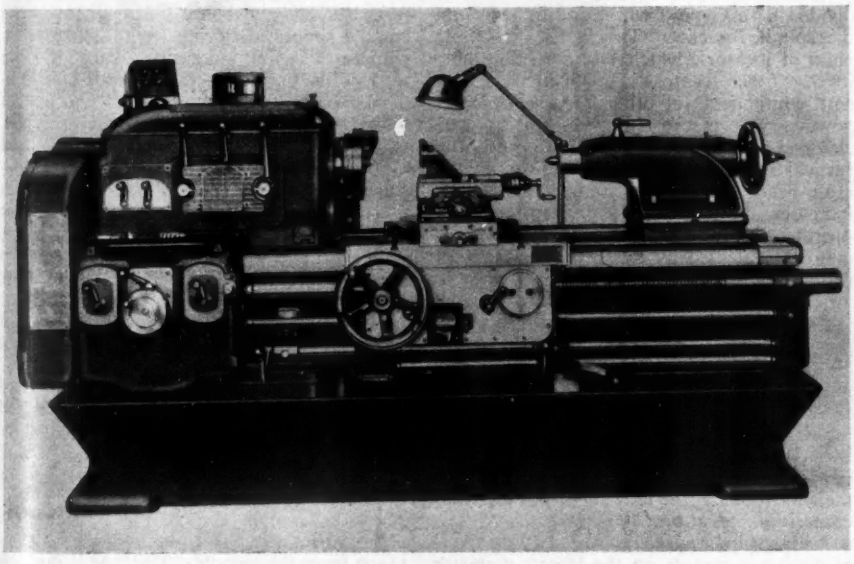


Fig. 4—Universal Relieving Lathe—Holbrook

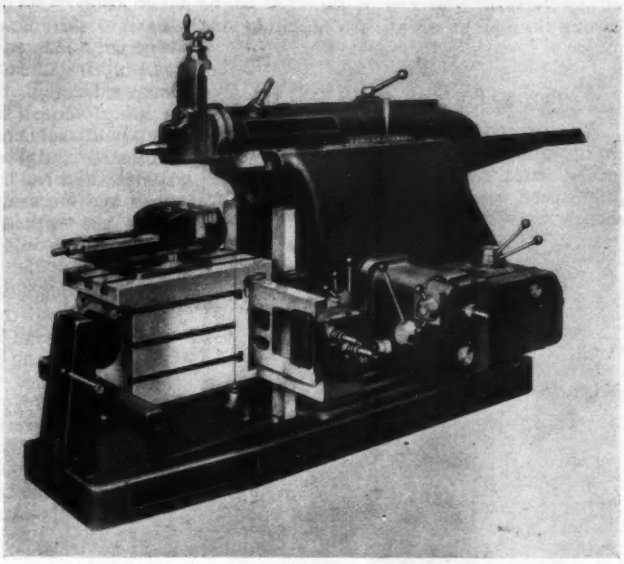


Fig. 5—Shaping Machine—Morrison, Marshall

Morrison, Marshall and Hill, Ltd.

The products of three firms are to be seen upon the stand taken by Morrison, Marshall and Hill, Ltd., of 44–45, Tower Hill, London, E.C.3. They include guillotines and a press brake of Rushworth and Co. (Sowerby Bridge), Ltd.; a shaping machine made by Graham and Normanton, Ltd.; and lathes made by D. Mitchell and Co., Ltd.

A new worm-geared undercrank guillotine introduced by Rushworth and Co. (Sowerby Bridge), Ltd., illustrated in Fig. 6, is one of the firm's 6ft by ¼in machines. The heavy cast iron side frames of this machine are machined for three stay bars and provide seatings for the cast bed, with which they form a rigid assembly. A ram which moves in long slides is balanced by springs fitted to the side frames, and the blade has adjusting screws.

Drive from the 4 h.p. motor is transmitted by vee belts to a flywheel and then through a worm and worm wheel coupled by a dog clutch to the centre of the eccentric shaft. Work is clamped by an inclined plate operated by cams on the eccentric shaft. The back guide incorporates a graduated rule in an adjustable slide and the movable back gauges are operated by screws with reference to a manometer scale.

The " Granor Major " 26in shaping machine (Fig. 5) is a recent development of

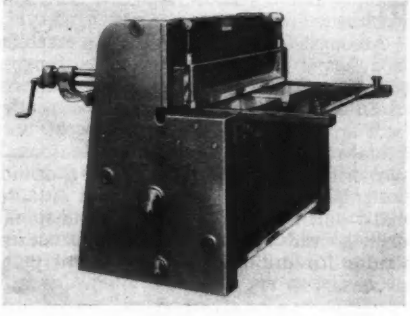


Fig. 6—Guillotine—Morrison, Marshall

Graham and Normanton, Ltd., of Halifax, and, in keeping with modern trends, is of clean design with a useful range of power feeds to the table. The machine is driven by a 10 h.p. motor through a multi-disc clutch to a nine-speed gearbox through which ram strokes can be varied from eight to ninety-three per minute. Provision is made to allow long work to be passed through the main frame and driving link underneath the ram for keyseating or other operations.

The box section cast iron table can be removed from the slotted apron front on to which large or bulky castings can be directly clamped for machining. Mechanical table traverse is effected through a gearbox giving eight variations of feed per ram stroke from 0·01in to 0·16in horizontally and from 0·004in to 0·063in vertically. The tool head also has means

of mechanical feed and is arranged to be swung through an arc of 45 deg. either side of zero.

FREDK. POLLARD AND CO., LTD.

The twenty-four drilling machines shown in operation by Fredk. Pollard and Co., Ltd., of Leicester, include representative types of high-speed sensitive machines, column and bench machines, general-purpose and special

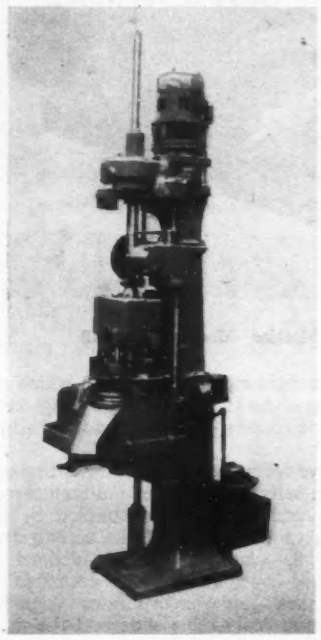


Fig. 7—Machine with Nut Drilling and Tapping Fixture—Pollard

upright machines, adjustable spindle machies, and special-purpose horizontal machines.

Amongst the vertical production machines is a heavy duty boring machine designed especially for boring and facing rear axle cases, and a smaller machine is shown fitted with an auto. indexing table. In the horizontal range is a five-spindle semi-automatic pin drilling machine designed for drilling cotter pin holes in bolts, &c., and an automatic unit machine fitted with multi-spindle drilling heads and a revolving and indexing fixture for drilling and reaming oil pump pistons.

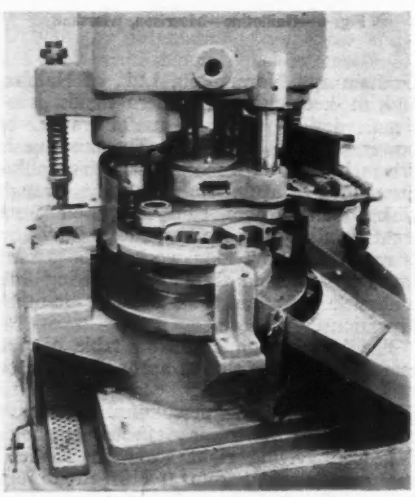


Fig. 8—Boring and Tapping Head—Pollard

In Fig. 7 is shown a 15in geared drive sensitive drilling machine, which has been especially adapted for the rapid production of ¼in " Instanter " nuts. The machine is of standard design, the main drive being from a 3 h.p. vertical flange motor fitted with a metal to rubber flexible coupling. The hardened and shaved gears to the main spindle drive run in an oil bath in the machine head and are safeguarded against overloads by a vee-tooth clutch. The drive to the feed motion is also contained in the machine head.

A four-spindle boring and tapping head (Fig. 8) fitted to the flanged quill of the machine is driven by a tang drive spindle and has self-reversing tap spindles. Feed to the head is controlled by a hardened cam, which is driven by a worm gear contained in the spindle bracket. An overload clutch is fitted to safeguard the mechanism, and pick-off gears are provided in the spindle bracket to vary the rate of feed and time cycle.

On a screw-elevated table is mounted a three-station revolving fixture, which is divided by a Geneva wheel and driven from the spindle bracket. The fixture has three pairs of locators, which are interchangeable so that other locators can be fitted to deal with components of other sizes. The components are placed in the locators and clamped only when in the boring position by vertical spring-loaded bars contained in the multi-head. When the head feeds down it increases the tension on the springs and operates toggle clamps, which are automatically released by the upward movement of the multi-head. At the tapping station is an arrangement, again operated by the vertical movement of the head, which prevents the nuts from lifting. Automatic ejection takes place as the table indexes.

The alignment required between the multi-head and fixtures is accurately maintained by two hardened and ground locating bars carried in the multi-head. These bars take their locations in the fixtures before the tools come into operation.

A high spindle speed, giving a cutting speed of 400ft per minute on the largest diameter of the tool, is used in order to make full use of tungsten carbide tools, and it is stated that a production rate of 700-½in nuts per hour can be maintained.

H. W. KEARNS AND CO., LTD.

The large horizontal surfacing, boring, milling, drilling and tapping machine, illustrated in Fig. 9, is one of a representative range of machines exhibited by H. W. Kearns and Co., Ltd., of Broadheath, Manchester. It is the firm's No. 5 model with a 6in. diameter spindle and in it the travelling spindle is combined with a built-in automatic facing chuck. As its travelling spindle can be revolved independently of the facing chuck, most drilling, tapping and—where the holes can be machined at high speed—boring can be done with the chuck stationary. This facing chuck, which can be used to machine diameters up to 4ft 6in, has the full range of twenty-four speeds of from 2·3 to 160 r.p.m. available to the spindle. The compound table carries a revolving table 5ft square.

The machine is fitted with a new " crawl-

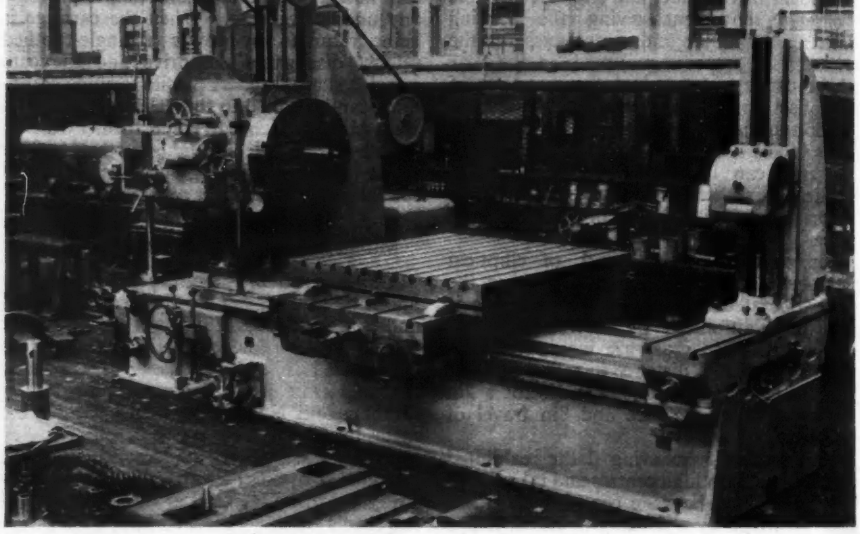


Fig. 9—Horizontal Boring Machine—Kearns

inch " arrangement to the compound motion of the tables, and vertical adjustment of the spindle slide and boring stay. This system employs a 7½ h.p. independent rapid traverse motor for providing three rates of movements to the units mentioned. The first of these movements is the normal rapid traverse, which is entirely independent of the feed motion. The second—the crawling rate—enables the table or spindle slide to approach its final position slowly, after using the rapid traverse motion. The third is a single impulse movement to any of these traverses of approximately 0·002in. A single lever operating through a gate controls electric braking, the forward and reverse directions to the three motions and the engagement of the automatic feeds.

The feed mechanism provides two feed ranges to all the motions—longitudinal and transverse traverses for the tables, the spindle slide vertical motion, the spindle traverse and the radial movement of the facing slides—through a single feed box. The " B " range of eight feeds in cuts per inch is from ⅛in to $^{1}/_{96}$in, and the drive is taken from the spindle. The " M " range in inches per minute is 0·8in to 10in and is

obtained from the constant-speed driving shaft in the drive box.

As the " M " range is independent of the spindle speed, a combination of a slow " M " feed with a fast spindle speed gives a small feed per revolution, and makes possible very smoothly finished work. Conversely, a coarse feed results from a fast " M " feed and a slow spindle speed. For special needs the whole range of " M " feeds can be easily altered by a simple change of gear ratio, and a single lever engages either range and the reverse to each.

Rapid traverse to the two table motions—the spindle slide vertical motion and the bearing on the stay—is provided by a separate drive from a 7½ h.p. motor in the rear of the bed.

The toolroom boring machine exhibited (Fig. 10) was developed by the firm some two years ago to bridge the gap between the normal high-grade boring machine and the jig borer. The machine is intended, where possible, to carry out to one setting and to a high degree of accuracy surfacing, boring, milling and drilling operations. It was described in detail in our issue of June 2, 1950, and its leading particulars are as follows : main table, 16in by 22in ; revolving table, 18in by 18in ; longitudinal traverse, 18in ; transverse traverse, 12in ; vertical traverse, 12in ; maximum distance from spindle nose to boring stay, 3ft 3in ; maximum diameter machine will face, 8in.

An optical measuring system, which is fitted to both the vertical and transverse motions of the machine, consists of a glass scale mounted in adjustable brackets. On each of these scales the markings in hundredths of an inch are engraved on the underside of the glass. The marks are projected on to a large ground glass screen, on which are widely spaced marks of the vernier scale for subdividing to 0·001in. It is claimed that with this system settings can be made to 0·001in to an accuracy of 0·00025in.

The machine is made in two models, which are similar in all respects except for the spindle slides. In a facing chuck model the spindle carries an automatic facing chuck with a facing capacity of 8in and provided with built-in mechanism for adjusting the slide whilst it is rotating. A surfacing feed box at the rear of the slide provides means for hand adjustment, and a single surfacing feed of 0·006in per revolution of the chuck. On the collet model machine the spindle slide carries a hollow spindle on ball and roller bearings. Its dead-length collet mechanism is designed to hold boring bars, drills, &c., up to 1¾in diameter.

Special ways on the bed support a central thrust boring stay with a bearing having the same length of vertical traverse as the spindle slide.

On both models of the machine a 1½ h.p. change-pole motor drives the spindle and, with a two-speed device on the spindle slide, it gives six spindle speeds from 40 to 500 r.p.m.

E. H. Jones (Machine Tools), Ltd.

The British-built equipment amongst the many machine tools shown by E. H. Jones (Machine Tools), Ltd., 10, Dover Street, London, W.1, includes a new C.V.A. single-spindle automatic known as the " Speed 8 " and having a bar capacity of ½in diameter.

The maker states that in designing this machine (see Fig. 12) no attempt has been made to follow conventional practice, although it can be used with machines of similar capacity, using existing cams and tooling equipment if required.

The turret of the machine is indexed by a Geneva motion which operates independently of the related " straight-line " tool withdrawal and advance movements of the slide. The operating mechanism for both indexing and slide withdrawal is wholly mounted on the bed of the machine, relieving the turret slide of weight and permitting an increase in the " tool clearing " stroke. Moreover, the turret can be both single and double indexed in the same cycle; alternatively, the slide can reciprocate without indexing, such as for the multi-pass deep hole drilling.

The reversible motor of the machine is enclosed within the cabinet and, by a short lightly loaded roller chain, drives the primary shaft of the gearbox. This gearbox provides thirty-nine work spindle speeds in twenty-six sets, ranging from 7700 to 200 r.p.m. ; the pairs being in common or opposite directions.

Two electro-magnetic multi-plate clutches in the gearbox provides two auto-change spindle speeds, and the gearbox directly drives through a spur pinion keyed to the work spindle.

The short work spindle is mounted on twin preloaded ball bearings front and rear and the collet gripping sleeve, which operates close to the front bearing, is of special ball-thrust design. An electromagnetically operated multi-plate brake holds the work spindle stationary when required.

A third vertical cross slide mounted above the spindle nose, and operated by one or by two cams on the front camshaft, is available as a normal third slide or as an overhead turning slide incorporating, when desired, a simple and effective provision for profile turning. The swing bar stop, while usable in the normal manner, can also be used when the chucking and bar feeding camshaft operates more than once per cycle, repeated

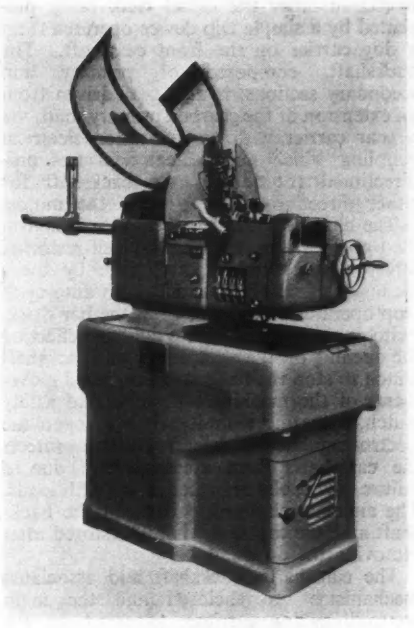


Fig. 12—Single-Spindle Automatic—Jones

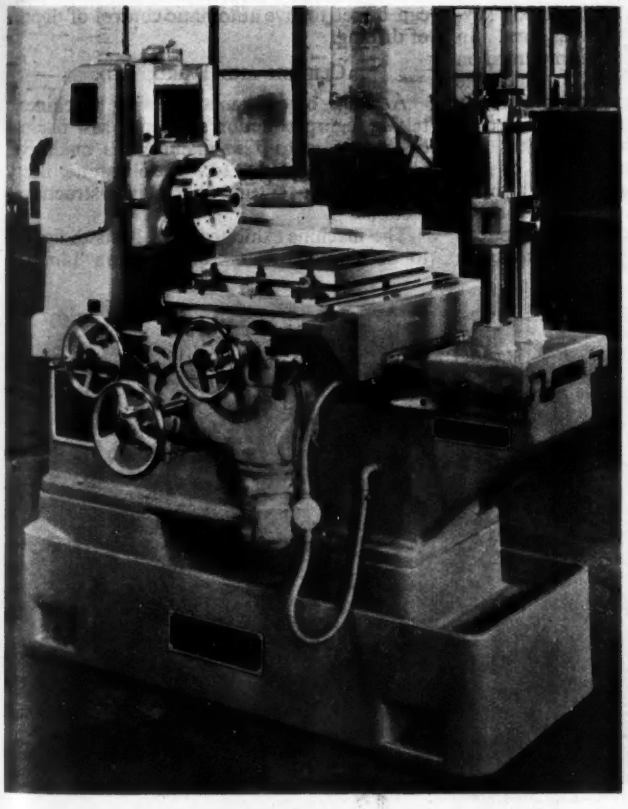


Fig. 10—Horizontal Toolroom Boring Machine—Kearns

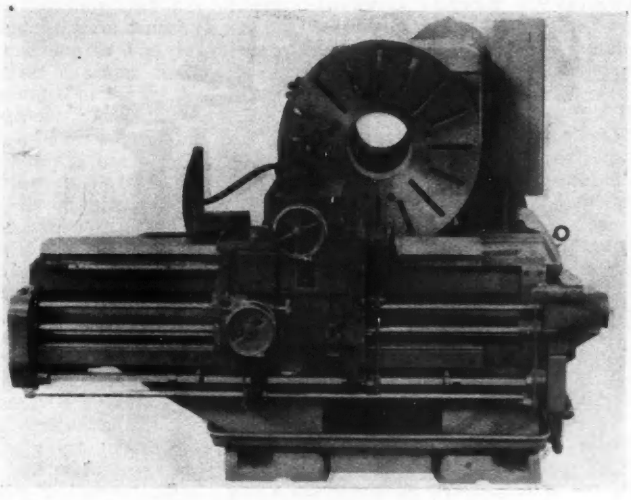


Fig. 11—Right-Angle Chucking Lathe—Jones

operation, after the initial feed, being prevented by a simple trip device operated from a dog carrier on the front camshaft. The backshaft, composed of primary and secondary sections, is also gear driven from an extension of the gearbox primary shaft, via a gear carrier with an associated electrical coupling which automatically ensures unidirectional rotation of the backshaft for either direction of rotation of the motor.

The chucking and bar feeding mechanism incorporates an automatic self-restoring safety device preventing damage by overfeeding or feed obstruction. An auto-cycle stop operates on exhaustion of the bar stock, switching on a red indicator light and effecting the opening of the electromagnetic backshaft clutch to stop the feeds and associated movements of the machine. An overload safety clutch, operating a limit switch to open the electromagnetic backshaft clutch, protects the camshafts from excessive load due to failure of tools or other abnormal loads. The angular relationship between the backshaft and the camshafts is self-restored after removing the overload.

The camshafts, backshaft and associated mechanisms are enclosed and the main controlling dog carriers, mounted on the front camshaft in a cluster, are arranged, conveniently, adjacent to the controlling push-button switch panel.

The turret camshaft, arranged transversely at the right end of the bed, carries the disc cam for turret slide feed and a cam for control of the independent indexing. The two cams for the rotation and feed of the transferring attachment are mounted, respectively, on and close to the adjoining ends of the front and turret camshafts. Indexing of the turret and the related withdrawal and advance slide movements are accomplished by associated, but independently separate, mechanisms, which are mounted on and within the bed. Screw-type lengthwise adjustment is provided, and the turning stroke is 1⅝in.

The cross-slides, which are provided with screw adjustment and dead stops, have a stroke of 1in.

A Lodge and Shipley "Model 7" right-angle chucking lathe exhibited amongst the plant of American design upon this stand is illustrated in Fig. 11. This machine, which swings work up to 60in diameter, is specially intended for facing, turning and boring thin-walled section work of large diameter and short length. It has a "T"-shaped bed with the head on the stem of the "T" and the carriage mounted on ways at

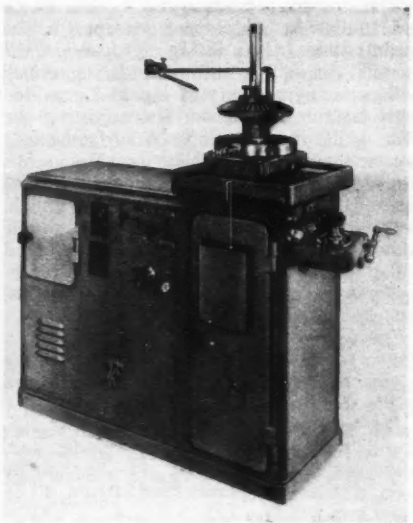


Fig. 15—Key-Seating Machine—Litton's

right angles on the top. The spindle of the head is bored 11½in diameter and is driven by a 15 h.p. motor through gearing giving speeds from 6 to 338 r.p.m. Both the carriage and the top slide have power feed in each direction of travel, there being fifty-five feeds from 0·001in to 0·064in per revolution of the spindle, as well as means of rapid power traverse.

Other equipment shown on this stand includes a range of C.V.A. Kearney and Trecker milling machines, C.V.A. dieing presses, and lathes made by C.V.A., and Smart and Brown, Ltd.

Litton's Machine Tool Company, Ltd.

The products of a number of foreign manufacturers are exhibited by Litton's Machine Tool Company, Ltd., of 372, Old Street, London, E.C.1, and amongst them is to be seen a recently introduced "M.A.C." key-seating machine made by a Swiss firm. In this machine (see Fig. 15) work is mounted on a table at one end of the base, in which the hydraulic drive unit and controls are totally enclosed. The work is centred and located on a rigid guide bar, in which a cutter bar reciprocates. The working stroke of this cutter bar is infinitely variable up to a maximum length of 19⅝in and work with bores from $\frac{9}{16}$in to 7⅞in can be handled. Five feed rates from 0·001in to 0·005in per stroke are available and automatic infeed of the cutter is given by a wedge at the rear of the cutter bar. The cutter bar and wedge move up and down together in the guide bar and feed is initiated by a small additional downward movement of the wedge at the beginning of each cutting stroke. On the return stroke pressure on the cutter is relieved to avoid excessive tool wear. The cutter bar is fully supported on three sides in the guide to prevent any tendency to sideways movement when working.

Controls for the machine are grouped on the side and through them the required depth of cut and feed rate can be set before the machine is started. When the predetermined depth of cut is reached the machine automatically stops.

The French machines on the stand include the "Pegard" No. 4, 2in bar capacity capstan, illustrated in Fig. 13, which is designed to swing up to 16¾in over the bed or 10¾in over the cross slide. This machine is driven by a two-speed motor through vee belts and a four-speed gearbox. It is also fitted with a back gear and this gives it a range of sixteen spindle speeds from 25 to 1250 r.p.m. The turret slide has a range of six feeds and both the saddle and the cross slide have three power feed rates. All the slides are fitted with power feed knock-out stops. A four-way indexing tool post is fitted to the front of the cross slide and this, combined with the back tool post, adapts the machine for a useful range of tooling.

On a 5ft 3in radial drilling machine made by Marcel Pegard there can be seen the new points of design introduced by the firm to give greater ease of operation. A single lever on the head is used to select any of nine spindle speeds from 180 to 2800 r.p.m., and another lever for the six feed ranges from 0·002in to 0·02in per revolution of the spindle. A third lever set in a gate selects forward and reverse spindle drive and controls raising and lowering of the arm. The arm and the saddle are locked simultaneously through another lever and a graduated dial can be set to give automatic control of depth of drilling.

Clifton and Baird, Ltd.

A range of cold metal sawing machines, taking high production segmental saw blades of from 14in to 72in diameter, is made by Clifton and Baird, Ltd., of Johnstone, near Glasgow, for cutting bars and structural sections.

The machine exhibited (Fig. 14) is designed to accommodate saw blades from 14in to

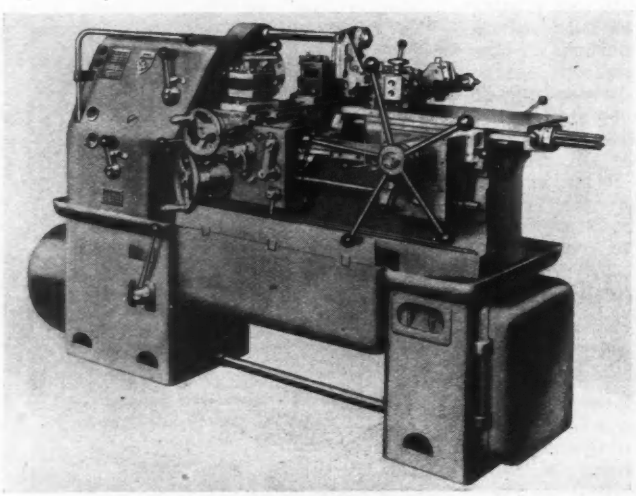


Fig. 13—Capstan Lathe—Litton's

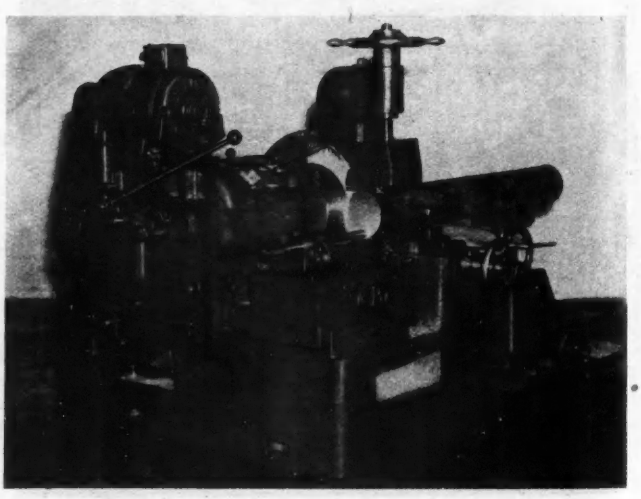


Fig. 14—Cold Metal Sawing Machine—Clifton and Baird

18in diameter and, when fitted with the largest blade, it has a maximum capacity for solid sections up to 5¾in diameter or 5¼in square, or structural sections up to 10in by 5¼in. It has three cutting speeds, giving 30ft, 44ft and 66ft per minute peripheral speeds of the saw—suitable for cutting all classes of steel, including the alloy steels now in common use. The drive is transmitted from a 5 h.p. constant-speed motor mounted on the saw saddle, through vee belts, speed change gears, a steel worm and phosphor-bronze worm wheel, and a final double helical gear.

The hydraulic pump and control valves for the saw saddle feed are contained in a compartment of the saddle, the drive to the pump being taken from the machine driving shaft. The piston is stationary and mounted centrally with the narrow guide of the bed slides, to prevent cross winding, whilst the cylinder is integral and travels with the saw saddle. During the cutting stroke there is pressure on each side of the piston to give a balanced feed, which is infinitely variable up to 25in per minute. Adjustable tappets automatically return the saw saddle on completion of the cutting stroke.

The vertical and horizontal vices of the machine are adjustable by handwheel to give a hammer blow for easy tightening and releasing. The vertical vice jaw rigidly holds the work on each side of the saw blade to ensure burrless cutting. The horizontal vice incorporates a universal work anvil, enabling round, square and structural material to be rigidly held. If required, the vertical vice may be arranged for mechanical operation from a separate, high torque, constant speed, reversing motor, controlled by push buttons.

A hand-operated roller, adjustable in height and raised by foot treadle, lifts the work clear of the table for easy entry. The cut-off length is measured by a suitably graduated adjustable gauge incorporated in the rear work support. The arm of this gauge swings clear, allowing the cut length to pass from the machine.

B. Elliott and Co., Ltd.

A representative range of machine tools and equipment made by B. Elliott and Co., Ltd., of Victoria Works, London, N.W.10, and its associated companies includes a number of machines of new and improved design.

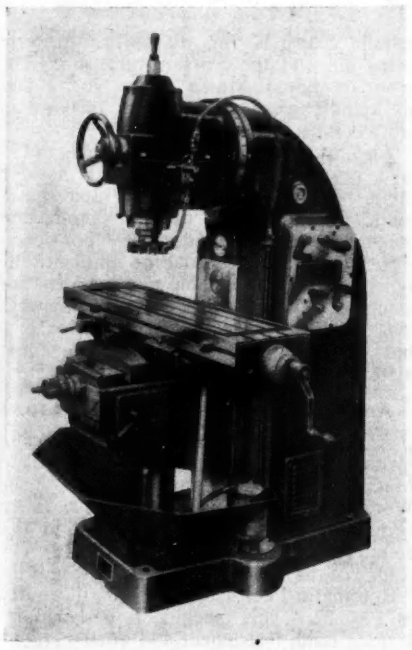


Fig. 16—Vertical Milling Machine—Elliott

One of the new machines is a " Victoria " vertical miller (Fig. 16), which has a table with a working surface of 40in by 11in. The machine has the power needed for effective use of carbide tools. The drive is transmitted from the 3 h.p. motor through a combined spindle speed and feed gearbox in the column. Through this box twelve spindle speeds from 32 to 1050 r.p.m. and eighteen feeds from 0·5in to 16·5in per minute can be selected. The head can be swivelled to the right or left through 45 deg. with reference to a large graduated scale, and it carries the spindle in four taper and one parallel roller bearings. A hand-operated vertical spindle movement of 3in is available, and during cutting the quill is locked firmly in position.

The " Invicta " high-speed shaping machine illustrated in Fig. 17 has been designed for continuous heavy-duty combined with simplicity of operation. It has a 24in stroke and the drive is taken from a 4 h.p. motor through a multi-disc clutch and six speed gearbox giving from eight to seventy-four strokes per minute. A cross slide carried on long narrow guides has a longitudinal traverse of just under 30in, and the six rates of power feed range from 0·010in to 0·060in per stroke. In the standard machine a table with a top surface of 23in

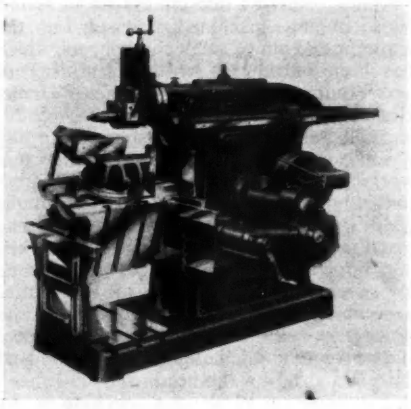


Fig. 17—24in Shaping Machine—Elliott

by 13in is fitted, but, if required, it can be replaced by a swivelling table incorporating a special support as shown in the illustration.

A group of " Progress " drilling machines shown on the stand includes the 2in capacity general-purpose pillar machine in Fig. 18. In this machine, the drive is taken direct from a 2½ h.p. flange-mounted motor on the head to a nine-speed gearbox. The standard machine is supplied with a 1400 r.p.m. motor giving a speed range of 58 to 839, but a lower speed range of 38 to 560 is available by fitting a 960 r.p.m. motor. Speed selection is made by levers operating in gates and arranged coaxially at the side of the gearbox.

The feed drive is taken from the main gearbox and operates through a worm gear and multi-tooth clutch to the rack pinion. Three ratios of automatic feed of 0·005in, 0·010in and 0·020in per revolution of the main spindle can be obtained, engagement being made by movement of a toggle action embodied in the star handwheel. Hand operation can be effected either direct by a star wheel or through a handwheel operating the worm gear mechanism for fine or heavy-duty feeding. Drilling to a predetermined depth can be read off a large calibrated dial on the pinion shaft, while a depth stop can

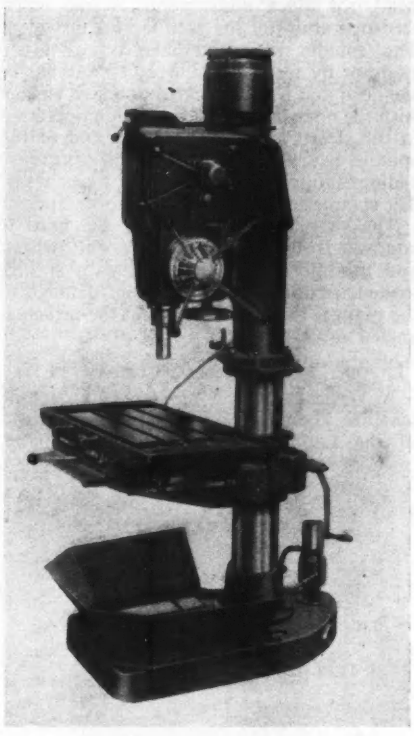


Fig. 18—General-Purpose Pillar Drill—Elliott

be set to throw out the feed drive at any position.

A new " Excel " surface grinding machine to be seen has hydraulically operated longitudinal feeds to the table which has a working surface of 24in by 8in. Its saddle, which carries the complete table unit, traverses on vee slides and cross feed can be operated by hand or electrically at each reversal of the table. This cross feed is variable from $\frac{1}{32}$in to ¼in and trips are provided to cut it out at predetermined positions.

Other exhibits on the stand include " Cardiff " lathes, hacksawing and bandsawing machines, and a variety of sheet metal working equipment and machine shop accessories.

Wadkin, Ltd.

High-production machines for the woodworking industries and woodworking machines for pattern shops are to be seen upon the stand taken by Wadkin, Ltd., Green Lane Works, Leicester. Of particular interest to patternmakers will be the firm's redesigned universal pattern miller, which incorporates a number of major improvements.

In previous designs of this machine the drive to the spindle was from a motor mounted at the opposite end of the arm to the cutter head and driving on to the cutter spindle through a shaft and worm and wheel gearing. On the new machine the drive to the spindle is by short-centre, flat, stretchless belt driving from a four-speed motor built into the headstock. The motor provides speeds of 4500, 3000, 2250 and 1500 r.p.m. A frequency changer built on to the end of the arm provides the top speed and the 2250 r.p.m. The remaining two speeds of 3000 and 1500 r.p.m. are obtained direct from the line.

The cutter spindle is mounted in ball bearings housed in a large-diameter sleeve, and a movement at right-angles to the arm is provided by means of a rack cut in the sleeve. The pinion engaging the sleeve is controlled by hand lever on the front of the

head, for quick adjustment. A fine screw feed operating on the rack is also provided. The spindle is counterbalanced at every position by means of a weight mounted in the head and having rack teeth which engage with the opposite side of the pinion operating in the sleeve rack. The driving end of the spindle has six solid splines ensuring easy sliding motion with freedom from wear. The spindle end is bored No. 5 morse taper.

The swivelling movement of the head is controlled by worm and worm wheel, and this mechanism incorporates a spring-loaded friction clutch to prevent damage to the plunger locating the head at the principal angles.

LAPOINT MACHINE TOOL COMPANY, LTD.

A vertical and a horizontal broaching machine shown in operation on the stand of the Lapoint Machine Tool Company,

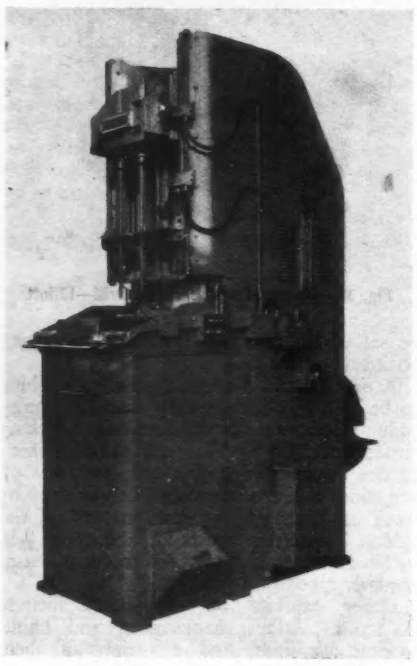


Fig. 19—Vertical Broaching Machine—Lapoint

Ltd., of Otterspool, Watford By-pass, Watford, Herts, are hydraulically operated, electrically controlled machines of fabricated steel construction.

One of these machines, the "V.3" vertical, automatic, internal pull-down unit shown in Fig. 19, which has a pulling capacity of 16 tons and 42in stroke, is representative of a range of eight similar machines, having capacities from 5 tons with 36in stroke, to 50 tons with 60in stroke. Its automatic receding table is built to accommodate one, two or three components, using one, two or three broaches simultaneously, according to the size of work, and the user's requirements.

The machine is hydraulically operated from a pump unit working at 1000 r.p.m., driven by a 30 h.p. main motor, while the coolant is supplied by a separate pump unit having ½ h.p. self-contained motor.

The machine is controlled by push-buttons at the front, which actuate solenoid-operated hydraulic valves, and an auxiliary control station is fitted at the side of the machine to facilitate setting up. The maximum travel of the main slide, which runs in hardened and ground steel ways, is 42in and this stroke enables the machine to work with broaches having a maximum length of 48in. Cutting speeds are variable up to 21ft per minute with a return speed of 42ft per minute, and an automatic broach lifting mechanism is fitted to eliminate need for handling the broaches during the operating cycle.

The platen on which the workpieces are located is of heavy, semi-steel construction and reciprocates to and from the broaching position to facilitate loading and unloading of the components.

Work-holders and broaches can be quickly interchanged when different workpieces have to be produced.

The hydraulic pump unit of the horizontal broaching machine is driven by a 7½ h.p. motor and it is one of a range of ten similar machines having capacities from 2½ tons and 30in stroke to 75 tons and 76in stroke. This machine has a normal pulling capacity of 10,000 lb and its maximum stroke is 30in. Cutting speeds are infinitely variable from 5ft to 29ft per minute and the maximum return speed is 75ft per minute.

A means of vertical adjustment is fitted to the broach puller head and the head itself is fitted with bronze shoes, running on hardened and ground slides. The machine is manually controlled from a conveniently placed lever, adjacent to which is a "start" and "stop" button for the main motor.

CENTRAL TOOL AND EQUIPMENT COMPANY, LTD.

Many points of interest are to be found in a milling machine, designed for the mass production of small components, which has been introduced by the Central Tool and Equipment Company, Ltd., of Hemel Hempstead, Herts. This machine (Fig. 20) is mounted on a rigid cabinet carrying a solid base upon which the 22in by 6in working surface table is traversed longitudinally over a stroke of 12in by hydraulic gear. As can be seen, the head of the machine is offset from the main centre-line and both the vertical and cross movements are effected by the head. For the 9in vertical movement the head slides bodily up and down the column and for cross movement the quill containing the spindle can be moved 2½in in and out of the head.

The main drive of the machine is by a direct current motor fed and controlled electronically from a three-phase alternating

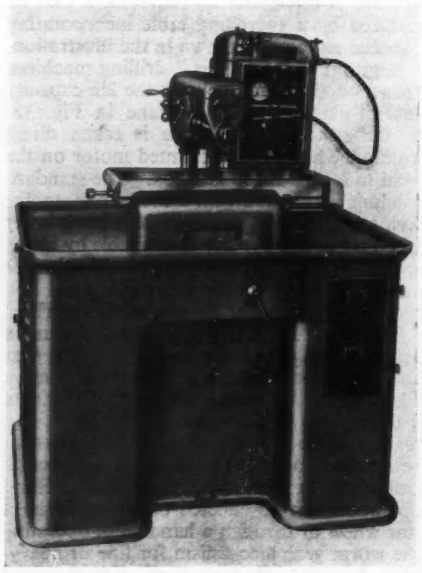


Fig. 20—Small Production Milling Machine—Central Tool

current supply. The spindle speeds are infinitely variable from 100 to 2800 r.p.m., the speeds being controlled by a simple dial operating a rheostat. This rheostat controls the speed in two overlapping speed ranges of 100 to 550 r.p.m. and 500 to 2800 r.p.m., which are selected by a simple gear change lever at the back of the machine. The infinite range of hydraulic table feeds from ¾in to 38in per minute is set by a dial on the feed selector valve and the table has fast approach and return speed of 360in per minute irrespective of the cutting feed.

The "Centec 2A" universal milling machine shown in Fig. 21 is fitted with a vertical swivelling head, which has a sliding spindle and can be used for milling and drilling at angles. It has a table with a working surface of 16in by 4¼in and, when used as an ordinary horizontal miller, the maximum distance between the table and

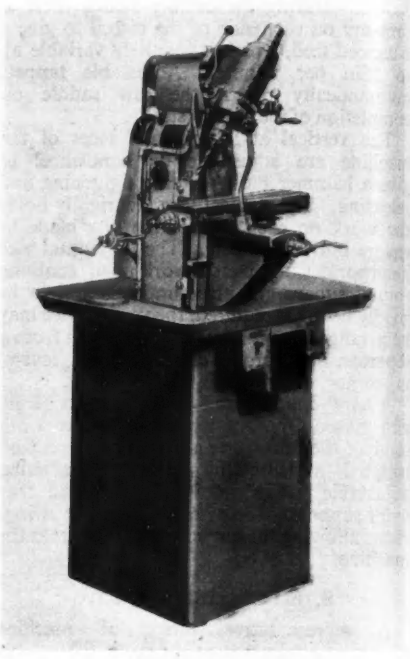


Fig. 21—Small Universal Milling Machine—Central Tool

spindle centre is 7in, the vertical traverse being 6in and the cross traverse 4in. The arbor is bored Morse taper No. 2 and six spindle speeds from 85 to 1400 r.p.m. are available.

Also to be seen upon this firm's stand is a new pneumatically operated indexing table, which is designed for rapid automatic indexing when used on production machines. It can be indexed by foot operation by a machine feeder or automatically synchronised with a table movement of the machine. Two, four, six or twelve divisions indexing can be selected by depression of a button without need for changing index plates.

ADAM MACHINE TOOL COMPANY, LTD.

A number of machines of Continental manufacture are being shown by the Adam Machine Tool Company, Ltd., of Acme Works, Waverley Road, St. Albans, Herts, several of them for the first time in this country.

One of the small machines to be seen is the "Rotomatic" coil-fed automatic, illustrated in Fig. 22. This machine is designed for turning small instrument and other parts up to ⅛in diameter and 1in long to precision limits from coil stock. It has a rotating

tool head in which two tools are mounted and have means of axial and radial adjustment. These tools can be set radially to the depth of cut, and independently of each other, whilst the machine is in operation. The stock is fed from the coil by two grooved feed rollers which can operate to advance the material between operations and also to feed it forwards during longitudinal turning if shoulders or points have to be formed.

During turning the material is supported in a guide bush in the tool head and opposite this bush is a holding collet, arranged as close as possible to the cutting tools. The opening and closing of this collet is controlled by a cam so that it holds the work firmly during machining or cutting off. At the end of the machining operation the finished workpieces are pushed out of the rear of the collet to fall into a tray separated from the swarf.

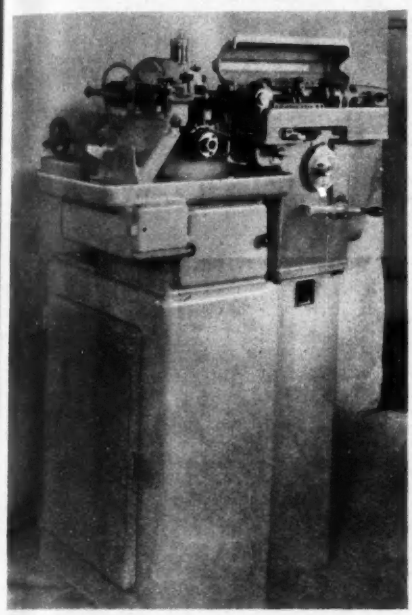


Fig. 22—"Rotomatic" Coil Feed Automatic—Adam

The tool head rotates at 6000 r.p.m. and the cycle can be set to produce from four to 100 parts a minute.

The Billeter automatic machine (Fig. 23) for drilling, engraving and contour milling is adaptable for a number of other kinds of work. In this machine the work table and the motor-driven tool head above it are pivoted on vertical bearings on the rigid base casting. Movements of the table and the head in a horizontal plane are controlled by two arms carrying tracers which are spring loaded into firm contact with a pair of cams. The cams are mounted on a vertical shaft driven by a motor in the base of the machine, and, as they rotate, their profile contours are converted to longitudinal and transverse movements of the work table and tool head. Vertical movements of the work table to give the required depth of cut are controlled through a lever by a "bell" cam arranged below the horizontal cams.

Another interesting machine for the high-speed production of small components, which is to be seen upon this stand, is the Haesler-Giauque "Multifactor" multi-spindle milling, drilling, tapping and turning machine. This machine consists of a central body which carries a horizontal indexing table round which are arranged clamping fixtures for the components to be machined. A series of tool heads arranged round the machine is driven by motors or hydraulic units and tooled up for the sequence of drilling, milling, tapping, &c., operations. If required, the component holding fixtures can also be arranged to rotate. The machine can be arranged for fully automatic feeding, coil or bar working, &c., to suit special components.

Abwood Tool and Engineering Company, Ltd.

A machine recently developed by the Abwood Tool and Engineering Company, Ltd., of Princes Road, Dartford, Kent, is the precision tool and die surface grinder, illustrated in Fig. 24. This vertical spindle machine has a 6in diameter wheel and a capacity of 20in by 8in by 10½in. Its spindle unit is complete with a 3 h.p. motor drive through vee belt and two-step pulleys and is mounted on a traversing head operated by a graduated handwheel to give the wheel a free movement over the full width of the table. The "Hydrocol" main spindle bearing, which is fitted with adjustable Timken taper roller bearings, is oil mist lubricated. Coolant is delivered through the centre of the grinding wheel spindle and also to the leading edge of the wheel. In passing through the spindle the coolant also serves to keep the main bearings cool. If required, the grinding head can be tilted up to 2 deg. either side of zero to give a lead for roughing or hollow grinding.

The table is carried on a substantial knee, which is moved vertically through a graduated handwheel to set the depth of cut. If required, a screw on a trip dog can be set to give an automatic depth feed of from 0·0002in to 0·001in at each table reversal. The table is traversed longitudinally by means of a capstan handwheel.

The grinding wheel speeds are 3200 or 6000 r.p.m., and the machine can be provided with a detachable high-speed spindle running at 13,100 r.p.m. This spindle is mounted on a bracket at the side of the main spindle head and is driven through a flat belt and special pulley attached to the spindle nose. It can be fitted with quills of various sizes for tool and die work.

This firm's "Concentre" machine for grinding and lapping carbide-tipped tools or high-speed steel tools, which is also shown, is made in two sizes for 8in and 12in diameter wheels. In this machine a large-diameter, high-tensile steel spindle is carried in adjustable taper roller bearings and carries a grinding or lapping wheel at each end. Each wheel is served by a table, which is adjustable over a wide range to permit the consistent grinding of the required tool angles with reference to large scales at the side. When required, a protractor rest can be fitted in a slot cut along the length of each table. This slot is also used for guiding a diamond wheel truing device. Large transparent plastic shields are arranged over each wheel and the machine has a built-in coolant system.

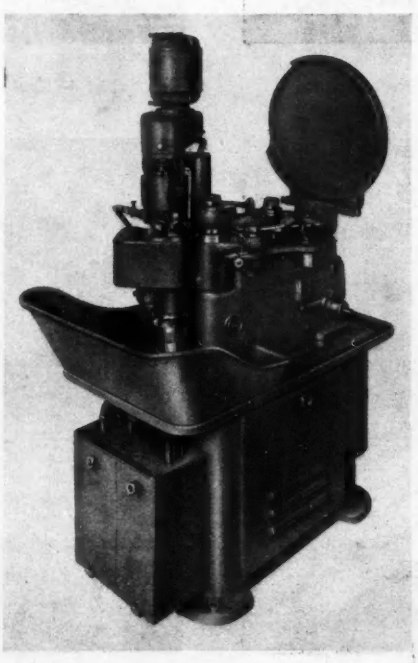


Fig. 23—Billeter Automatic Machine—Adam

Wild-Barfield Electric Furnaces, Ltd.

The display arranged by Wild-Barfield Electric Furnaces, Ltd., of Watford, Herts, is designed to draw attention to examples of modern practice in gas carburising, carbonitriding and induction heating.

Fig. 24—Surface Grinder—Abwood

The gas carburising exhibit traces the process from the entry of the raw town's gas into the gas preparation unit, where its deleterious constituents are removed, to the gas carburising furnace. Microphotographs used to demonstrate the effects of such treatment show the control of the carbon gradient in the surface of the steel.

Two working equipments exhibited include the Wild-Barfield high-frequency universal workhead and a typical application of low or normal frequency induction heating.

High-frequency induction-heating equipment has now reached the stage where the work handling jig is of primary importance and, with this in mind, the firm has designed a universal workhead to which can be fitted any number of handling jigs. Based on the principle of portable panels, which need only to be "plugged in" to the front of the workhead, these jigs can incorporate automatic and semi-automatic devices for loading and unloading. A range of these jigs is displayed together with a selection of photographs of special purpose machines designed for brazing, soldering, melting and other high-frequency induction-heating applications.

(*To be continued*)

ALUMINIUM SHEATHING OF CABLES

Fig. 1—Gantry Carrying Cable Sheathing Plant

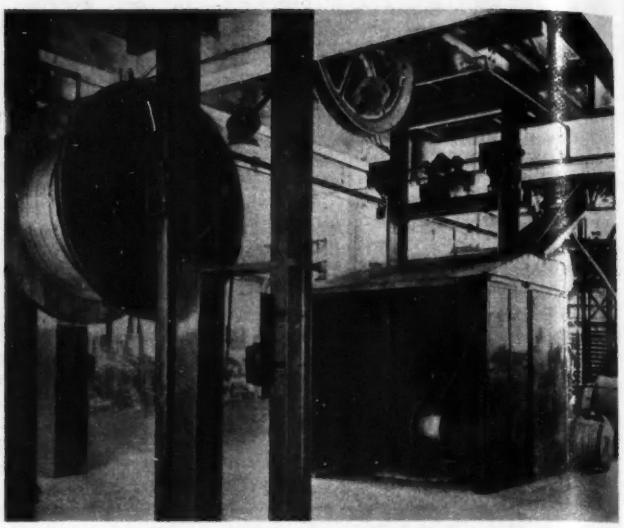


Fig. 2—Feeder Drums for Aluminium Tube (Left) and Cable Core (Right)

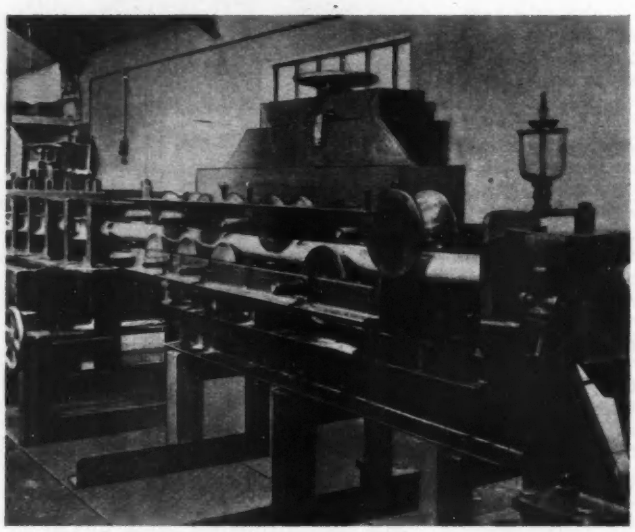


Fig. 3—Aluminium Tube Passing Through Straightening Rollers

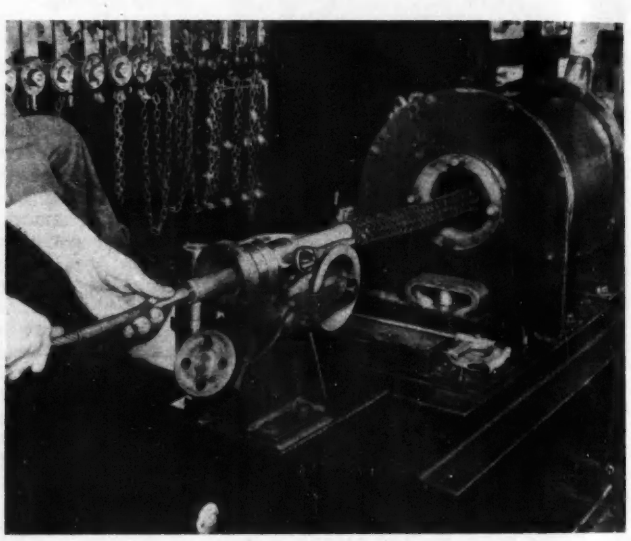


Fig. 4—Steel Armature Being Inserted into Aluminium Tube

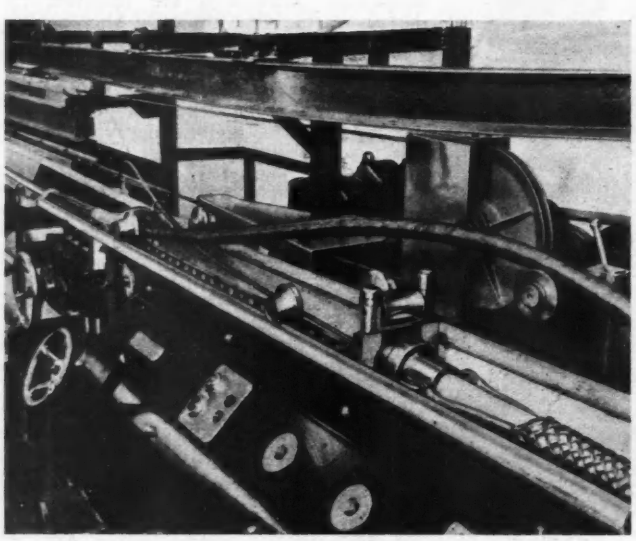


Fig. 5—Coupling Between First and Second Lengths of Tube

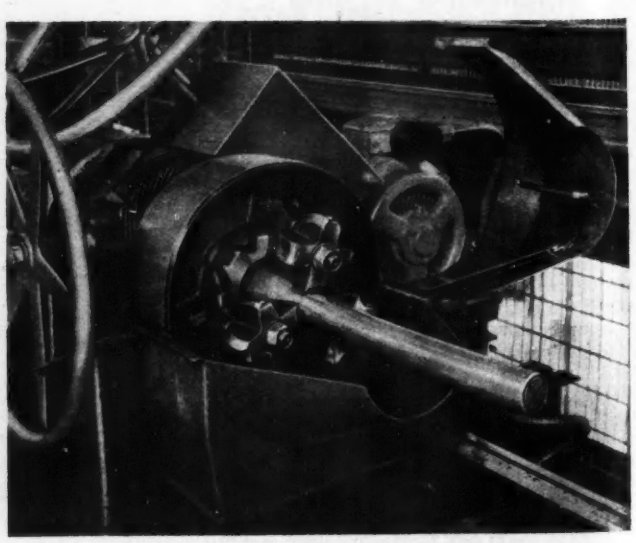


Fig. 6—Swaging Machine with Cowl Raised

Aluminium Cable Sheathing

The use of aluminium instead of lead for cable sheathing was first given serious consideration in Germany shortly before the second world war. Two methods of manufacture were considered: first, the extrusion of a sheath and, second, the application of a sheath in the form of a strip with a welded seam. British cable makers became seriously interested in aluminium sheathing after the war, when lead was scarce and expensive. One outcome of this interest forms the subject of the following article. It outlines a process developed by Johnson and Phillips, Ltd., for sheathing a cable by dieing down an oversize aluminium tube on to an insulated cable core. This process was seen in operation on a recent visit to the works.*

BRIEFLY, the sheathing process developed by Johnson and Phillips, Ltd., involves the threading of an insulated cable core into a continuous length of oversized, pre-extruded aluminium tube and the sinking down of this tube to form a seamless close-fitting sheath for the core. An important requirement for translating this principle into a commercial production process is that of providing a long, straight run for the plant so that the process of threading the core and sinking the aluminium sheath can be applied to reasonably long lengths of cable. To fulfil this condition without occupying valuable floor space the company decided to install the plant on a specially constructed gantry, built on the roof supports of a 350 yard-long cable shop, as shown in Fig. 1. Accordingly, allowing for the space occupied by the terminal plant it is possible to deal with lengths of 300 to 310 yards of oversize tube.

The layout of the sheathing installation is shown diagrammatically herewith (Fig. 7), from which it can be seen that the intake of the tube and core takes place at one end of the shop (the "feeding end") and the sheathing and coiling of the finished cable at the other end (the "sinking end").

For the purpose of describing the process it can be divided into three distinct operations. The first is that of laying out the tube, up to 300 yards in length, in a trough running along the plant gantry. The second is that of drawing the cable core into the tube. The third is that of drawing the tube, with the core inside it, through fixed dies and then over a hauling capstan, whence the finished cable is coiled on to a drum.

The sequence of events can be followed with the help of the diagrams (*a*) to (*e*), Fig. 8. For the first operation the aluminium tube is fed from its drum (mounted on a stand just above ground level) over a large guide-wheel to the plant gantry, where the leading end of the tube is threaded through a series of straightening rollers (Fig. 3). There are appropriate sets of straightening rollers to suit the various sizes of tube that are used for cable sheathing. A general view of the "feeding" end of the plant is given in Fig. 2, which shows, on the left, the drum carrying the tube and, on the right, the drum carrying the cable core. To ensure that the tube is taken from the drum over the guide wheel without distortion the height of the drum above floor level can be varied by the vertical lead screws which can be seen in Fig. 2. The height of the drum is determined by a photo-electric cell installation, in which the drum, in its normal position, breaks the path of a beam of light. Part of the guide wheel can be seen at the top of Fig. 2. The guide wheel is carried on roller bearings, which allow it to move laterally along the shaft so as to accommodate the tube, without distortion, as it is wound off the drum.

It is necessary to provide a simple means of threading the core through the tube after the latter has been laid out along the gantry. To do this the leading end of the tube, after being passed through the straightening rollers, is threaded through the centre of a solenoid electromagnet, which can be seen on the right of Fig. 4.

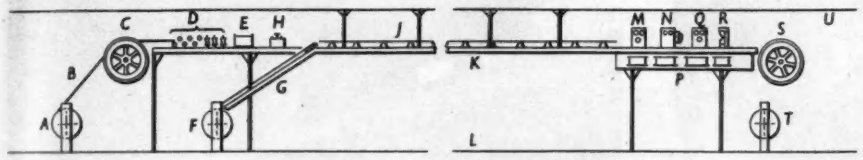
The function of the electromagnet is to "anchor" one end of a towline at the feeding end ready for the cable core, while a second towline is attached to the leading end of the tube in preparation for hauling the tube along the gantry. To hold the feeding end of the cable core tow line it is fitted with a steel armature, which is inserted (Fig. 4) into the aluminium tube lying within the electromagnet. This is roughly the position indicated by diagram (*a*), Fig. 8. The leading end of the tube is then prepared for attachment to its tow line, with the help of a steel wire mesh "stocking" and a steel collar, as can be seen in Fig. 4. The tail end of the "stocking" is bound with wire and tape to the tube and the tension set up in the individual wires of the "stocking," when the tow line is being hauled, causes the pull to be distributed evenly over some 18in length of the tube. The electromagnet is then energised so that the armature is held in position. At the same time tension is applied to the tube tow line by an electrically driven capstan (*P*, Fig. 7), which operates through the medium of a Vickers V.S.G. drive; thus, the tube is drawn over the core tow line along the process trough, which can be seen in Fig. 5. This stage of the process is depicted diagrammatically at (*b*), Fig. 8.

When the required length of tube has been drawn over the core tow line, preparations are completed for the second main stage in the process—that of drawing the cable core into the tube. The electromagnet is de-energised and the tow line within the tube is made fast to the leading end of the cable core, which is fed up a ramp *G*, Fig. 7, from the cable drum at ground level. Then, by starting up the winch at the sinking end of the plant the cable core is drawn into the tube.

Two more tasks remain before the cable is ready for the final operation, that of sinking the tube to form the sheath. First the cable core tow line is returned by a conveyor system (via another trough extending over the length of the gantry) to the feeding end of the plant in preparation for handling the second length of tube and cable core. This length of tube, like its predecessor, is brought through the electromagnet ((*c*), Fig. 8), via the gantry and straightening rollers. The leading edge of this second tube is then connected by a special coupler unit (Fig. 5) to the tail end of the first tube; accordingly, when the first length is later drawn through the sinking dies to complete the sheathing, the second length of tube is drawn into position in the troughs *J* along the gantry.

Preparatory to sinking, however, the first length of tube, with the core inside it, is drawn forward into a swaging machine (Fig. 6) and the first 12in or so are swaged down to allow the two sinking dies to be threaded on. The three-jaw swaging head is rotated by an electric motor, as the swaging machine is traversed manually, by turning a handwheel, along the portion of cable to be swaged. The swaging is carried out in a series of traverses, the diameter of the swaging jaws being reduced, between each traverse, by operating the second handwheel. As shown in the illustration, each of the three jaws carries a four-part swaging tool, which can be preset in any one of four positions so that the machine is capable of handling a wide range of tube diameters.

After the swaging operation the two sinking dies are threaded on to the end of the sheathed cable, which is then attached to the hauling tow line in the way described above. On starting up the capstan the tube is drawn through the dies (Fig. 10) and sunk down to form a close-fitting sheath on the cable core. As shown in the illustration, oil is fed on to the tube before it enters the dies, to serve as a lubricant. On emerging from the dies (Fig. 9) the sheathed cable passes round the hauling capstan (Fig. 11) for a few turns and is then taken to ground level, where it is coiled on a drum ready for test. At this point it should be noted ((*d*), Fig. 8) that an "additional" length of core has been left protruding beyond the end of the tube at the tail end of the plant. This provision is



A.—Drum of aluminium tube.
B.—Aluminium tube.
C.—Guide wheel.
D.—Straightening rollers.
E.—Electromagnet.
F.—Drum of cable core.
G.—Ramp to gantry.
H.—Control unit.
J.—Troughs.
K.—Gantry.
L.—Floor of shop.
M.—Control unit.
N.—Swaging Machine.
P.—Hauling gear.
Q.—Control unit.
R.—Die stand.
S.—Hauling capstan.
T.—Drum for aluminium sheathed cable.
U.—Roof of shop.

Fig. 7—Diagrammatic Arrangement of Sheathing Process

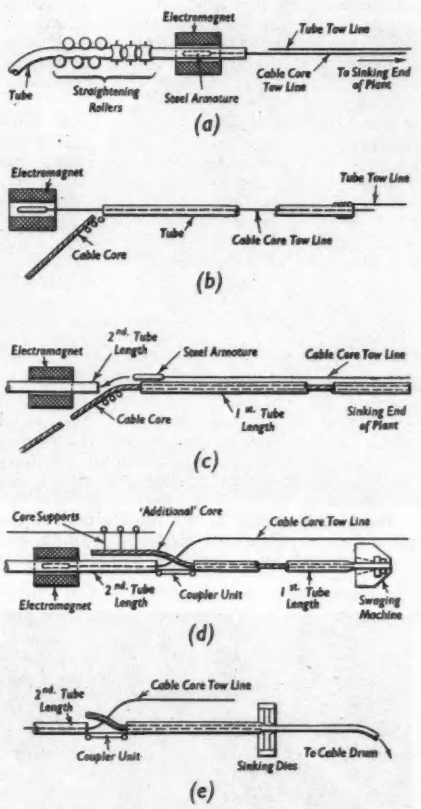


Fig. 8—Stages in Sheathing Process

* See also THE ENGINEER, April 23 and 30, 1948.

made to allow for the elongation of the tube that accompanies the reduction in overall diameter during the sinking process. As the operation proceeds, the additional length of core is drawn into the tube and sheathed. Depending on the reduction in diameter, an initial length of 300 yards of tube may yield between 333 yards and 440 yards of sheathed cable, and the difference between the original and final length determines the amount of surplus cable core that must be allowed for. During the sinking operation the protruding length of surplus core is normally laid in the trough. In the heavier sizes of cable, however, the surplus core is carried on a line of sliding supports which travel along a rail above the main trough (Fig. 5).

Referring to (*e*), Fig. 8, it can be seen that, as the first length of cable is drawn through the dies, the second length of tube, with the cable core tow line threaded through it, is drawn along the gantry. When the sinking operation has been completed on the first length of cable the second length of tube is, therefore, ready to have its cable core pulled through, and the full cycle of the process is complete. Successive lengths of tube and cable core are dealt with by repeating the cycle.

Two complete sheathing plants of the kind described above are housed side by side in the gantry. Both plants are identical in design and are operated independently of each other. Normally one plant may be used for sheathing paper insulated power cables, and the other for sheathing, say, v.i.r. distribution cables. But the functions of either plant can be varied readily by changing the dies at the sinking end to suit any desired change in the size of the tube, and by fitting the appropriate set of straightening rollers at the feeding end. The tubes are made in a standard range of sizes, rising in steps of $\frac{1}{8}$in up to 1in diameter and in steps of $\frac{1}{4}$in above that diameter. The lengths of aluminium tube are made of commercial purity aluminium in light alloy extruding presses and are brought to the sheathing plant at Charlton coiled on drums similar to those used for cables.

The electromagnet at the feeding end of the plant has a substantial electrical loading and it is supplied by a separate motor generator

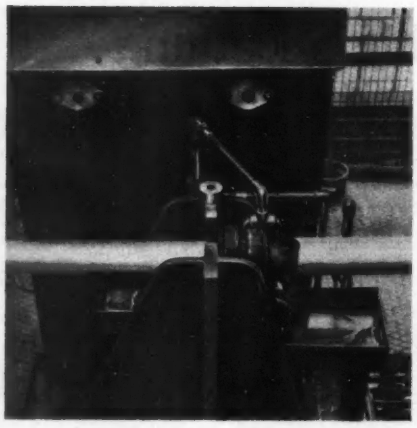


Fig. 10—Cable Being Drawn Through Sinking Dies

set installed at ground level. Typical figures for the input current and voltage are 300A at 90V (d.c.) and water cooling is employed to dissipate the heat generated. A control panel beside the electromagnet houses an ammeter, a voltmeter and push buttons for starting and stopping the motor generator set and operating the contactor controlling the electromagnet.

All the controls for the hauling capstan drive are embodied in a control panel, which can be seen behind the sinking die in Fig. 10. There are "start" and "stop" push buttons and a speed-control handwheel for the 80 h.p. capstan motor. A counter is fitted to give an indication of the length of finished cable in yards.

The co-ordination of the process is generally in the hands of the operator at the sinking end of the plant, who has an assistant to help him with the swaging and dieing. Instant communication between the sinking and feeding ends of the plant and intermediate points along the gantry is obtained by means of a wired microphone and loudspeaker system.

Development

The installation described in this article is the outcome of experimental work which began in November, 1946, at the Kynoch works of Imperial Chemical Industries, Ltd., who undertook to provide Johnson and Phillips, Ltd., with the long lengths of aluminium tube required for the sheathing process. The experience gained from these early experiments was sufficiently encouraging to prove that the process was both practicable and commercially promising. During the next six months, therefore, it was possible to concentrate on developing a method of integrating the successive operations of positioning the tube, inserting the core and forming the sheath into an economic mechanised production process.

By August, 1947, the project had graduated from the experimental stage and plans were made for the design and construction of a permanent plant at the company's Charlton works. Installation of the first production unit was completed in May, 1948, and two months later the first orders for aluminium sheathed cable were being executed.

For the first twelve months aluminium sheathing was mainly confined to paper insulated cables but, before the end of 1949, long lengths of smaller diameter tubes became available, allowing the process to be extended to rubber insulated cables for wiring and control circuits. A quantity of high-frequency cable was also sheathed to the order of the Telegraph Construction and Maintenance Company, Ltd.

To meet the demand for aluminium sheathed cable it was decided in 1950 to duplicate the initial plant and to extend its length. This work was completed by August, 1951. The time required for a sheathing operation depends partly on the cable, but a general indication of the productive capacity of the installation is given in the statement that the average output of the plant is 3000 to 4000 yards of power cable in a ten-hour shift.

To date the company has supplied a total of 2100 miles of aluminium sheathed cables; this total is made up of more than 1100 miles of paper insulated cable, nearly 900 miles of rubber insulated cable, and some 100 miles of high-frequency cable.

Fig. 9—Sinking End of Plant Gantry

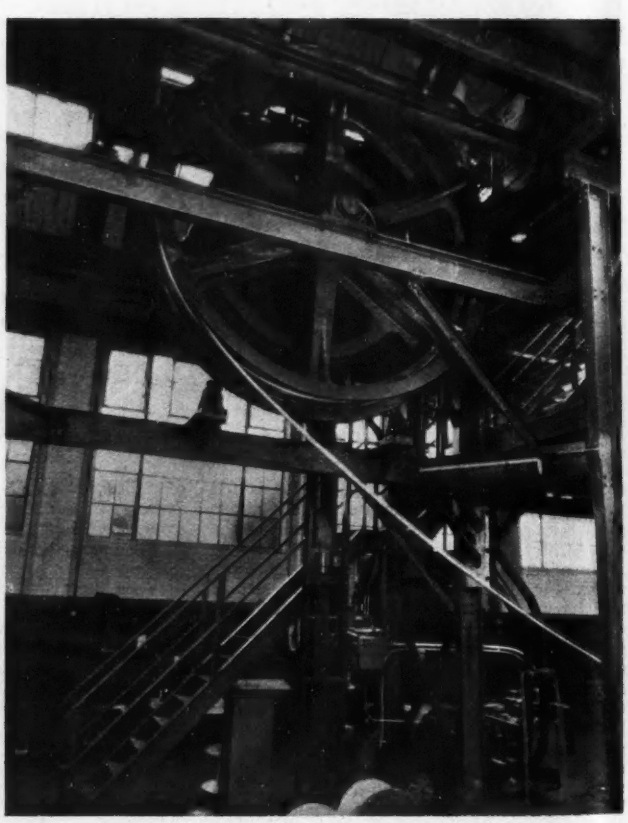


Fig. 11—Hauling Capstan

The Trostre Tinplate Works

No. I

An important part of the reconstruction project for the South Wales sheet, steel, and tinplate industry is the tinplate plant of the Steel Company of Wales, Ltd., at Trostre, near Llanelly. This plant is now in production and will eventually receive some 7000 tons of hot-rolled coil a week from the Abbey Works for processing into 140,000 boxes of tinplate a week.

IN the articles we published last year dealing with the formation of the Steel Company of Wales, Ltd., and the new works at Margam* it was noted that as an integral part of this reconstruction in the South Wales sheet, steel and tinplate industry there were to be two cold reduction mills and a modern tinplate plant. One of the cold mills was to be placed by the continuous mill at Margam, whilst the other, together with the tinplate plant, was to be situated at Trostre, near Llanelly. These works at Trostre are now almost completed and a majority of the plant installed and in operation. The plant is now producing about 5000 tons a week and it is expected that by the early part of next year it will be receiving some 7000 tons of hot-rolled coil a week from Margam for processing into 140,000 boxes of tinplate.

The site selected for the Trostre works was 420 acres of low-lying ground adjoining the London-Fishguard railway line about a mile from the sea. Work commenced in August, 1947, and after the initial clearance of the site, moving farms, hedges, trees, &c., it was necessary to lay an ash carpet over the area to be occupied by the plant. This was done by bringing lorry loads of filling material from surrounding works tips and spreading it to an average depth of 2ft over the whole area, thus increasing its level to 16ft A.O.D. In order to bring this filling to the site temporary access roads with a total length of some 8500ft were built. After about 1,190,000 tons of fill had been placed, 26,000 concrete piles, 17½in diameter, were made on site and driven to an average depth of 24ft. This piling was carried out by West's Piling and Construction Company, Ltd., and "Ciment Fondu" was used extensively in making the pile shells, as composite Fondu-Portland piles were specified by the consulting engineers. The object of this was to form the lower part of the pile in "Ciment Fondu" as a protection against deleterious organic acids, and the upper part in Portland cement where these acids were not present.

* See THE ENGINEER of July 27, November 2, 9, 16, 23, 30, December 7 and 14, 1951.

All the piles were driven to good sets, the pile shoes penetrating shaley rock over all parts of the site at depths varying from 7ft 6in to 80ft. The plant itself covers an area of about 236 acres and in its design full advantage was taken of the underlying rock which was present on the site, and the foundations of some of the heavy equipment, such as the five-stand cold reduction mill and temper mills, were placed directly on rock.

To ensure safety from floods and provide natural drainage it was decided to raise the mill floor to 28 A.O.D., and as a number of pipe tunnels and cellars were required for mechanical and electrical equipment a form of cellular construction was adopted for large areas between the ground and the mill floor. In the building of the foundations some 170,000 cubic yards of concrete and 10,500 tons of steel reinforcement were used. The plant buildings are steel-framed structures with brick cladding, and in their construction some 9000 tons of steelwork and five million bricks were used. All of the structural steelwork above crane girder level was shot blasted, metalised with aluminium and then resin dipped to give added protection against corrosion. The buildings have the "high-low" design of roof, which gives excellent natural lighting at all levels in the bays.

The rolling mill machinery for the cold reduction mill and temper mills was obtained from the United States, and shipments of this equipment arrived at regular intervals from October, 1948, onwards. Altogether 6000 tons of machinery arrived in this way and, on arrival, heavy items, such as mill housings, were stored at the docks while smaller items, together with equipment delivered from British manufacturers, was stored in a disused works nearby, which was specially adapted for this purpose.

All the foundation bolts for holding down the machinery were set body fast in the concrete, the tolerance permitted being not more than $\frac{1}{16}$in in any direction, and the fact that there were more than 10,000 such bolts varying from 4in to 1in in diameter gives some idea of the work involved.

A special beam was designed to enable two overhead cranes to be linked together to lower into position the heavy mill housings, the heaviest of which weighed nearly 100 tons each.

An interesting point in the layout of the main works building is the use of a personnel tunnel, which extends across the full width below floor level from the clocking-in office situated midway along one side of the building to the far side. From this tunnel access is given to each bay by the shortest route, and by using it personnel do not have to walk through other departments when entering and leaving the building.

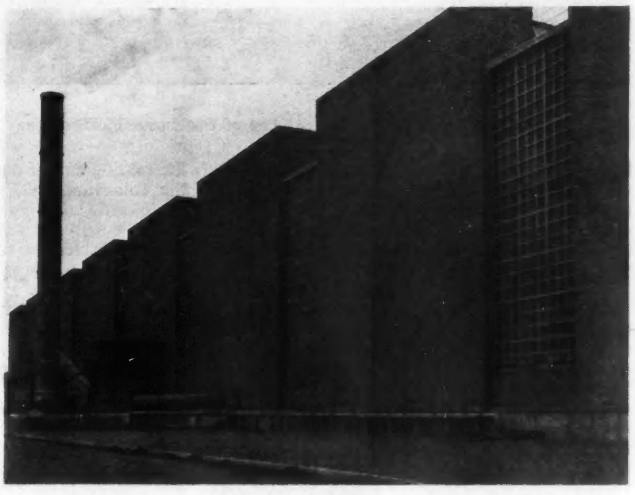


Fig. 2—Trostre Works

The main mill building, which has a total length of 2280ft, consists of five bays of 120ft span and one of 60ft span, the height to the crane gantries being 35ft throughout. The building can be seen in course of erection in one of the photographs we reproduce. The structural steelwork was supplied by Dorman Long and Co., Ltd., and the consulting engineers for this work were W. S. Atkins and Partners; L. G. Mouchel and Partners, Ltd., were consultants for foundations, &c., and R. M. Douglas Ltd., the main contractors.

In the building the stanchions supporting the crane girders and roof frames are arranged at 40ft centres with intermediate posts carrying side glazing and supporting the external brick walls. In the roof, of "high-low" design, the purlins on the high roof cantilever over the main roof frame, and the hangers supporting the low roof are slung on them. Glazing is set across the bays at each end of each high roof section. The roof covering is of trough section aluminium decking, insulated with boarding and bituminous felt.

Except for the crane girders, which are of welded construction, the steelwork is of orthodox riveted construction, the site joints being made with black bolts. The crane girders are designed as simply supported beams with flange plates 1¼in thick and 18in wide, the depth of the girders being 5ft. Arranged at 4ft centres are 6in by ½in flat stiffeners with four 8in by ½in flat stiffeners at each end over the supports. All of these stiffeners are welded to ⅜in thick bearing pads welded to the inside of the flange plates.

The edges of the compression flange plate are

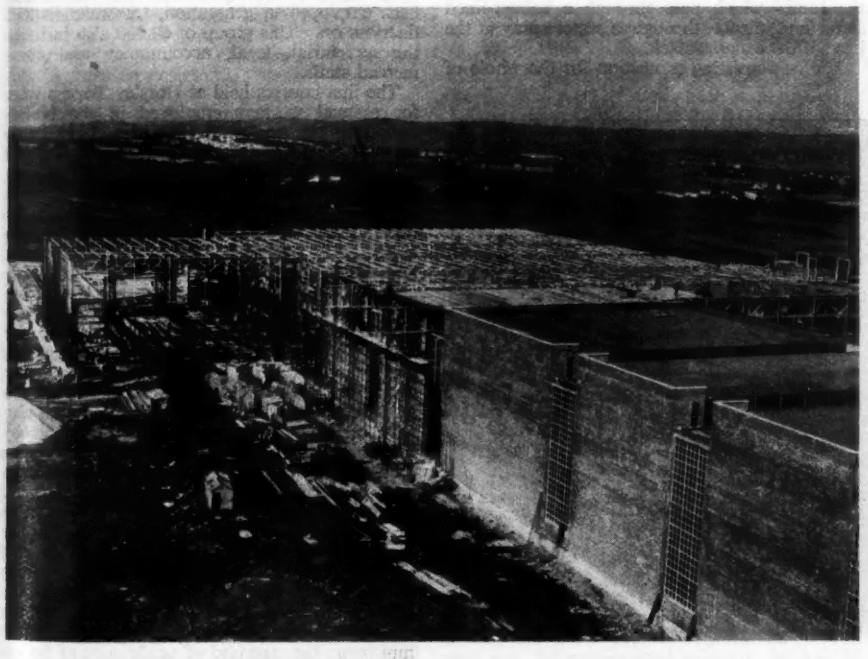


Fig. 1—Annealing Shop and Main Mill Bays in Course of Construction

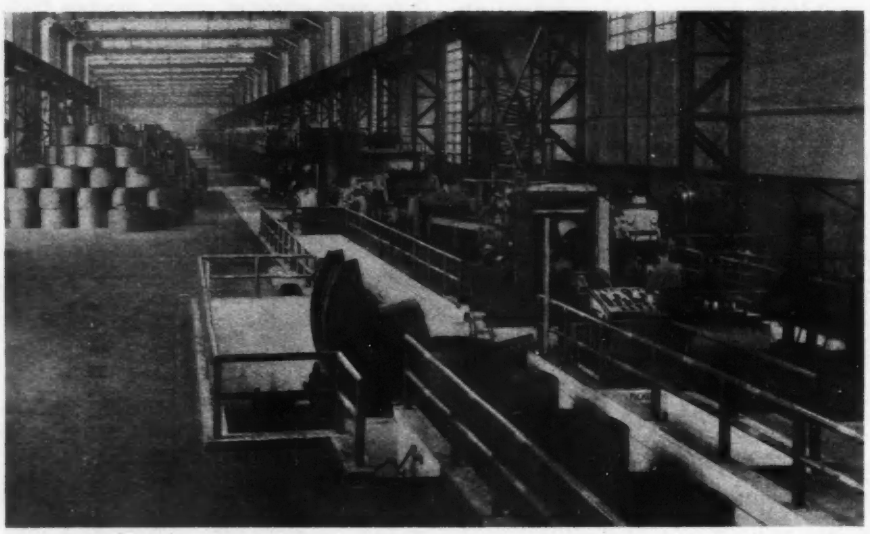


Fig. 3—Feed End of Continuous Pickling Line

stiffened by a 4in. by ½in longitudinal flat running the full length of the girder. The girders are not connected together over the supports, but diaphragms are provided at the stanchions. A flat-bottom crane rail is welded to the girder with ½in continuous fillet weld.

The production flow in the works is so arranged that hot-rolled coils of metal delivered by rail from the mills at Margam are taken straight into an unloading bay along the side of the main storage area. Processing is carried out along the full length of one side of the building, across the width of the bays at the top and then down the opposite side. With this layout processing is completed near the outgoing railhead adjacent to the raw material delivery bay. If necessary, the hot-rolled coils from Margam or elsewhere can be delivered by road on lorries which have easy access into the unloading docks in the stores area.

The hot-rolled coils are supplied in various steel qualities as scheduled by the cold reduction plant. The maximum individual coil weight is 15,000 lb in widths up to 38in and gauges up to 0·093in. From the stores area each coil in turn is transferred on a roller conveyor to an uncoiler at the head of the continuous pickling line, illustrated in the photograph we reproduce above. As the strip is uncoiled it is subjected to a reverse bending operation which serves to break up the scale. The strip then passes along a section of rollers to a shears, in which the end is trimmed. As the pickling operation is continuous, it is necessary to attach the trailing end of one coil to the leading end of the following coil. This operation is done by electric welding and stitching alternately. When it leaves the stitching or welding machine the strip is fed by pinch rolls into a 12ft deep looping pit, which is designed to hold a reserve of strip to provide a feed of material to the continuous pickling plant whilst the incoming coils are being connected to the trailing ends. A second set of pinch rolls draw the strip out of the looping pit and delivers it to the first acid tank in the pickling line.

In this pickling line there are five 80ft acid tanks containing different strengths of sulphuric acid, through which the strip is passed at a maximum speed of 500ft per minute to remove the scale formed during the hot rolling process. Following these five tanks are two water spray washing machines, cold and hot respectively, which wash off all adhering acid, and with the help of steam-heated air, dry the strip.

Each acid tank is of steel construction, rubber lined and protected by a 9in thick acid-resisting brick lining. The acid is fed continuously into No. 5 tank, from which it cascades through the remaining tanks against the flow of the strip. The pickle liquor in the tanks is heated by submerged steam jets, the temperature being thermostatically controlled.

Each tank is provided with a hood to collect the fumes which pass through a rubber-lined sewer and thence through a water spray at the base of the exhaust stack.

The acid-resisting protection for the whole of the concrete foundation where the tanks of the pickling plant are arranged was carried out by Prodorite, Ltd., of Wednesbury, and consists of Staffordshire blue bricks laid and jointed in an acid-resisting cement on a layer of mastic. This firm also did the acid-resisting brickwork in some of the pickling tanks, where the brickwork acts as a mechanical and thermal protection to the rubber lining of the tanks. The lining for three of the tanks was supplied by Tanks and Linings, Ltd., of Droitwich, and this firm's technique and materials were used throughout. The rear course of bricks was laid on " Nutrabon " plasticised sulphur cement and the front course set in " Nutrakey " furane resin mortar.

The washed and dried strip is fed from the pickling plant into a second looping pit, which forms a reservoir of material in front of the next operation, as can be seen in Fig. 4 on this page. In this operation the strips are sheared at the joints made prior to entry into the pickling plant and the stitch sections are cut out. The strip is then side trimmed to remove ragged edges and recoiled into lengths weighing 30,000 lb. During this recoiling the sheets are given a coating of hot palm oil, and the completed coils are ejected on to a ramp to the storage area in front of the cold reduction mill line.

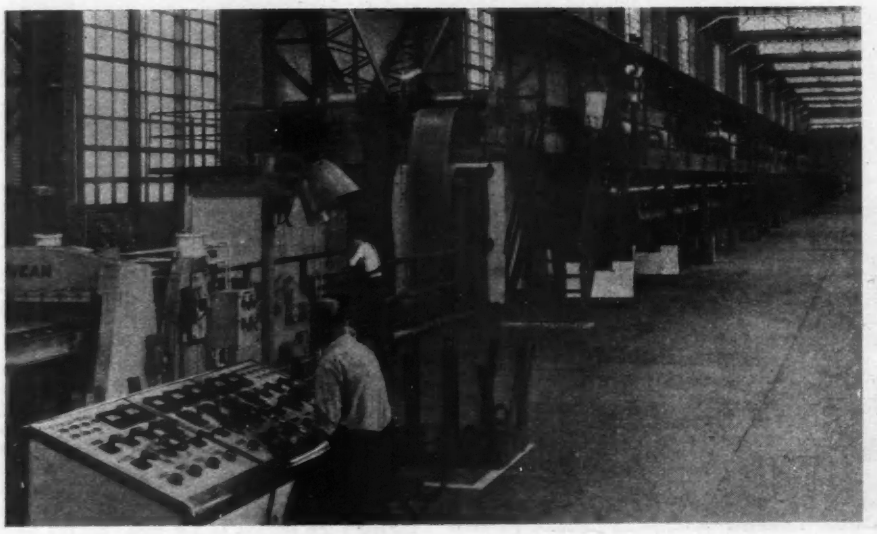


Fig. 4—Exit End of Continuous Pickling Line

(*To be continued*)

Training of Employees in the Electricity Supply Industry

A visit to Horsley Towers, Surrey, last week, at the invitation of the British Electricity Authority, gave us the opportunity of seeing something of the Authority's efforts to provide training facilities for various groups of its employees. Horsley Towers, which has accommodation for 100 students, is one of two residential centres which have been established by the Authority; the other is at Electricity Hall, Buxton, where over sixty students can be accommodated.

It may be recalled that one of the obligations imposed on the B.E.A. and the Area Boards by the Electricity Act of 1947 is that of providing facilities for training its employees. The size of the task can be appreciated from the fact that the electricity supply industry has nearly 180,000 employees of whom more than 120,000 are manual workers, including craftsmen, plant operators and unskilled workers. The remaining 60,000 employees comprise technical, clerical and administrative staff, including engineers, many of whom are specialists, employed in generation, transmission and distribution. This group of 60,000 also includes the secretarial, legal, accountancy and commercial staffs.

The first courses held at Horsley Towers were for manual workers employed in the boiler-houses of the power stations, the object being to give elementary technical instruction to those who were operating the plant. It was recognised that, as the main economics in a power station were those appertaining to the boiler-house, every effort should be made to ensure that operators carried out their work with maximum efficiency. It was also appreciated that many operators are recruited from labourers and learn to operate the plant on the job itself. A course was therefore devised to give instruction on elementary principles concerning heat, temperature, fuels, combustion and boiler operation. The underlying purpose was to help them, not only to understand how, but also why, certain operations are carried out, thereby increasing their interest, the principle being that the best service is given by people who find satisfaction in their work because they are interested in it. Some indication of the value of the boiler-house courses is given by the fact that the Steel Company of Wales and the National Coal Board have asked for facilities for some of their employees to attend the courses for boiler operatives in which they are particularly interested. Since any help towards improving the standard of proficiency of boiler-house personnel and the efficient combustion

of fuel is in the national interest, the Authority is complying with the requests. Accordingly, two employees from the Steel Company of Wales have already attended a course and others will be following. Similarly, the South Eastern Division of the National Coal Board will be sending two men to each course. When the value of the boiler-house operatives courses was established, similar courses were introduced for those responsible for operating the turbines and auxiliary plant.

Specialist syllabuses, covering such subjects as corrosion fatigue and crack detection, protective gear, American practice and European practice, also Civil Defence, have been organised for technical staff. Other courses include introductory or background courses for newly joined employees and graduate trainees.

In the realm of industrial relations there have been management courses for power station superintendents and courses on joint consultation for members of Local Advisory Committees, which are the joint consultative bodies at shop and office level. A list of the courses run at Horsley Towers since it was opened as a training centre is tabulated herewith.

Courses Held at Horsley Towers

Title of Course	No. of Courses held	Total Number attending
Boiler House Operatives Course ...	41	1,034
Turbine House Operatives Course ...	8	233
Local Advisory Committee Members Course	26	600
Protective Gear Course	2	91
Corrosion Fatigue Conference	1	47
Management Course for Power Station Superintendents	1	25
Background Course for Graduate Trainees	7	105
Education and Training Officers Conference	1	20
Induction Courses for Headquarters Staff	11	188
Conference on European Practice in Electricity Supply	1	94
Conference on American Practice in Electricity Supply	2	112
Service Centre Staff Course	2	59
London Board and Division Course	2	106
Southern Division Courses	14	329
Spring and Summer Schools	4	392
Civil Defence Courses	8	321
	131	3,756

Each course includes a programme of talks, the speakers being, in the main, persons employed in the industry; those for Horsley Towers are generally drawn from the southern part of the country. All courses embody the idea of planned discussion groups, when opportunities are taken to introduce topics of discussion relevant to the subject of the course. All the normal educational media are used, including films, diagrams, simple laboratory experiments and demonstration apparatus.

Demonstration rooms have been established, using equipment lent by many manufacturers, who ensure that it is kept up to date. This equipment includes power station models, pulverisers, CO_2 recorders, boiler fittings, instrument panels, parts of turbines, switchgear, voltage regulators, circuit breakers, a wide range of cables and joints, different methods of illumination and a number of instruments and testing equipment. A safety exhibition is now being built up.

Considerable importance is attached to the methods of selection for various courses and no compulsion is exercised. In the case of boiler-house operatives and turbine drivers, notices inviting applications to attend courses are posted in the power stations. Subsequently, selection is made by the respective power station superintendents to ensure there is no interference with the operation of the station. For the technical courses men employed on the particular aspect of work with which the course deals are selected by management. The local advisory committee courses are made up of representatives nominated by the committees themselves, two being selected from each. Employees are paid their normal wages and salaries whilst attending courses and they receive free accommodation and travel vouchers.

Horsley Towers first became associated with the electricity supply industry in 1939, when it was bought by the Central Electricity Board to provide office accommodation during the war. The property was built originally by William Currie, to the design of Sir Charles Barrie, the architect of the Houses of Parliament. It was later enlarged by the first Earl of Lovelace, whose family occupied it until it was bought by Mr. T. O. M. Sopwith. Subsequently it became a girls' boarding school. In April, 1948, the property vested in the British Electricity Authority and in November, 1949, after the engineering staff had been transferred to London, it was adapted for its present purpose as an education and training establishment.

The residential accommodation is in huts, partitioned into cubicles, and in the main building. Besides the lecture rooms, laboratory and demonstration room, the accommodation includes a library, a cinema and a licensed club. Facilities for tennis, cricket, football and fishing are provided within the grounds, all under the control of the sports and social club managed by a committee of members. The domestic side is under the joint care of a manager and manageress. The educational work is under the supervision of the resident tutor, Mr. J. W. Graely, who is assisted by an instructor, Mr. S. W. Cooper.

An Aluminium School Building

We are informed by the Bristol Aeroplane Company, Ltd., that it has been responsible for the construction of Limbrick Wood County Primary School, Coventry, which is claimed to be the first school of its kind to be opened. It is of unit construction with aluminium structural and cladding units. The school has been designed for 580 junior and infant children, the cost being within the governmental limit of £140 per place. This system of construction is being developed, it is stated, to buildings of up to three storeys in height.

The first pupils were admitted to Limbrick Wood School roughly a year after the work of construction began. The firm points out that unskilled men can quickly be trained in the rudiments of the simple erection process, which is in six stages. First, an extruded aluminium perimeter channel is bolted to the concrete slab already prepared. Two wall panels are then erected opposite each other at one end of the site and the gable-end panels and roof gable are then bolted in position. In the next stage, panels and roof units are erected along the length of the building. When the outer shell is complete, the internal partitions are bolted in position and, finally, the ceiling is fixed. This is the procedure for a single-span building, but a similar method is used for more complicated layouts. The units can be manipulated without the use of cranes and with light lifting tackle only.

A Machine Centre

A new machine centre has been built and equipped by F. J. Edwards, Ltd., at Islington Park Street, London, N.1, for the display, demonstration and reconditioning of the sheet metal working machines and machine tools the firm manufactures and markets.

The new centre, which has an area of some 150,000 square feet, consists of offices and a main display floor over 400ft long and 160ft wide, with a gallery along the full length at each side. The main floor, a photograph of which is reproduced herewith, is used for the display of the larger machines which are arranged in groups along its length. Two 20 tons capacity overhead electric cranes, which serve the main floor, facilitate the placing and movement of individual machines without interference to adjoining equipment. Each of the galleries is served by a 5-ton overhead crane and is used for the display of the lighter sheet metal working machines and machine tools.

Heavy Machine Groups

When it is required to demonstrate a machine in operation it is lifted from its group by a crane and transferred to a demonstration area where power and other services are installed. Doors at the end of the building are sufficiently large to admit road vehicles which can be loaded or unloaded directly by means of the cranes.

Machine reconditioning is carried out in a separate section beneath one of the galleries, and this section incorporates a well-equipped machine shop, degreasing plant, &c. In another bay the fleet of lorries, cars and other transport equipment of the firm are serviced and overhauled.

A smaller building near the centre is used for the inspection and storage of woodworking machines, tin box plant and general engineering equipment handled by the firm. This smaller establishment is self-contained with showrooms, workshops and an export packing section.

Farnborough Air Accident.—Investigation into the causes of the accident to the D.H.110 at the Farnborough Air Show on Saturday, September 6th, has been materially assisted by the return of various pieces of wreckage picked up by people in the vicinity. Even the smallest piece of wreckage can help in determining the cause of the accident and it is believed that others may have picked up further pieces. It would greatly assist the Chief Inspector of Accidents if any such pieces could be sent as soon as possible to the Structures Department, Royal Aircraft Establishment, Farnborough, Hants.

Metallurgical Topics

Cavitation Experiments

DAMAGE to metallic materials may result from rapid impingement of a liquid on a metal, for if the pressure due to high velocity drops to the vapour pressure of the liquid, it will vaporise and form a vapour cavity. At a slight increase in pressure this bubble will collapse and will cause a concentrated liquid impact. This sudden shock loading will cause erosion and pitting of the metal surface. The designer of hydraulic machinery has, in addition to producing a proper design, to select, with due regard to efficiency and economy, material which will offer the greatest resistance to cavitation damage. Surface treatment may be a help in this direction, and as a contribution to this subject N. Grossman[1] has made a short study of the effect of shot peening on damage caused by cavitation.

An important investigation on cavitation was made fifteen years ago by S. L. Kerr,[2] who

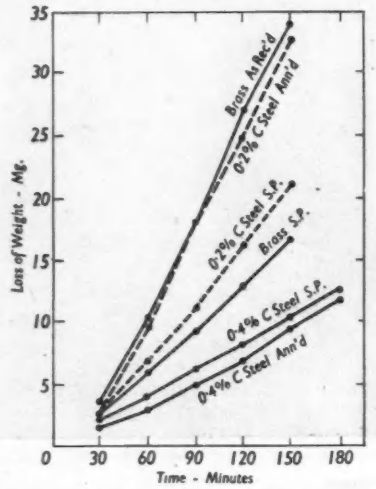


Fig. 1—Cavitation Experiments (N. Grossman)

designed a vibratory method of test in which the specimen, immersed horizontally in a liquid, was rigidly attached to the end of a vertical nickel tube which was kept in a condition of rapid vertical oscillation at its natural frequency in a high-frequency magnetic field. This type of apparatus was used by Grossman to ascertain the effect of shot peening on resistance to cavitation. He carried out tests on a specimen of brass containing copper 66·5, zinc 33·4 per cent with a Vickers hardness of 112, and on two annealed carbon steels having the following properties :—

Carbon per cent	0·21	0·44
Yield point, tons per square inch ...	18·4	25·9
Tensile strength, tons per square inch	28·6	42·4
Elongation, per cent on 8in	20	20

The Vickers hardness numbers were given as 114 and 152 ; the latter is abnormally low compared with the tensile strength. Frequency and amplitude of vibration were kept constant, and the resultant loss of weight measured at regular intervals. The results are shown in Fig. 1.

The author ignored the effects produced in the first thirty minutes, as representing unstable phenomena, and measured the rate of cavitation by the subsequent loss of weight per unit time. He thus found that the decrease in cavitation damage as a result of shot peening amounted to 58 per cent for brass, 42 per cent for 0·2 per cent carbon steel and 7 per cent for 0·44 per cent carbon steel. In the softer materials shot peening produced a very evident improvement, but the evidence for any improvement in the 0·44 carbon steel seems doubtful in view of the actual figures, which were :—

	Loss of weight, g. In 30 min	In 180 min
(1) Annealed	0·0019	0·0123
Shot peened	0·0019	0·0124
(2) Annealed	0·0008	0·0122
Shot peened	0·0026	0·0127

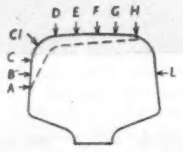
For this work to gain practical significance a wider range of materials must be investigated. For propeller material a 66 : 34 copper-zinc alloy is found, for example, to be greatly inferior to copper-zinc-nickel alloys or other high-tensile brasses ;[3] and it remains to be proved whether shot peening can confer a sufficient or lasting improvement on a low-grade alloy. Further, distilled water only was used in these experiments. In sea-water or other corrosive fluid behaviour may be very different.

Further investigation of shot peening as an economic method of improving resistance to cavitation, providing comparative data of value, would be welcome ; but, as the author states, "judicious caution should be exercised in applying these laboratory data to engineering field problems, where cavitation conditions may be quite different from those presented in these controlled tests."

[1] *Bulletin, American Society for Testing Materials*, July, 1952, page 61.
[2] *Trans. Am.Soc.Mech.Eng.*, 1937, Vol. 59, page 373.
[3] See, for example, R. Beeching : *Trans. Inst. Engineers and Shipbuilders, Scotland*, 1946-47, Vol. 90, page 203.

Black Stains on Railway Rails

A CO-OPERATIVE investigation on causes of the formation of black stains on the running surface of rails has been carried out during the last few years in Germany, and a report of the findings has been published by Walter Janiche.[1] These black patches are a familiar sight on worn rails. Careful measurements of the profile of the rail head showed that depressions occurred at positions corresponding to the appearance of black stains. At the depression, deposits of corrosion products accumulate and such places appear darker than the smooth, bright running surface of the rail. All positions in the head of a worn rail show more or less



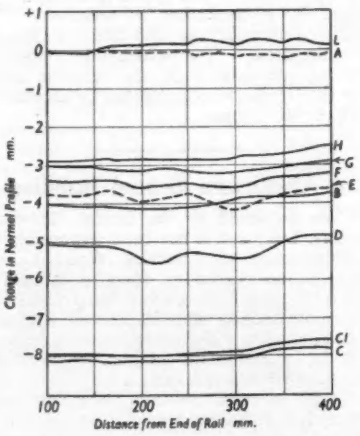


Fig. 1—Change of Surface Profile at Black Stains 150-350mm from End of Rail (Janiche)

departure from the original profile. The reported changes in the profile of a typical rail at the positions indicated are shown in Fig. 1. The greatest wear, about 8mm, was at *C* and *C1*. at *D* and *E* there were marked local depressions in the region of black stains. In the section of another rail, at 2mm to 4mm from the surface, which was bright, an internal crack 8mm long was observed, and below it a smaller crack 2·5mm long. These fatigue cracks would in due course reach the surface at the running edge, and a depression with accumulation of corrosion products would be formed on the otherwise bright surface.

The working party formed to explain the cause of black stains had the opportunity in 1950 of inspecting a number of rails showing this defect in a section of railroad near Cologne. The position from which rails were taken for detailed examination is recorded in the report with a plan of the track. Chemical analysis, mechanical properties, maker and process of manufacture are given. The extent of the defective appearance was expressed by the total length of the black stains as a percentage of the length of the rail. Some rails were quite without stains. In others the stained region varied from 13 to 45 per cent of the total length. The occurrence of black stains showed no definite correlation with chemical composition or mechanical properties. On the other hand, in many cases micro-examination of sections revealed an accumulation, in the head of the rail, of non-metallic inclusions which, under the transverse stresses produced by the compressive loads on the tread of the rail, had become linked together by cracks. This occurrence of non-metallic inclusions—usually

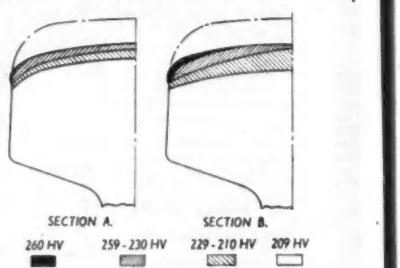


Fig. 2—Cold Working and Wear of Rail No. 3 (Janiche)

silicates or alumina—was associated with black stains, or recognised as producing the conditions necessary for their formation. In exceptionally highly stressed rails—switch-points, frogs, crossings and curves—black stains occurred without underlying non-metallic inclusions. The strong lateral shearing stress induced in the rail head leads to flow of metal from the crown, resulting in burrs or laps. It must therefore be recognised that working conditions and working stresses are of significance in the development of black stains.

Photomicrographs are given to illustrate burr formation. The seam formed becomes filled with corrosion product ; the crack is deepened by corrosion fatigue due to compressive alternating stresses, and the corrosion products are squeezed out giving black stains. At the same time, the lap becomes severely cold worked on the upper side and the edge of the rail crumbles away. The degree of cold working found to occur in two sections of one particular rail of tensile strength 44·5 tons per square inch is shown in Fig. 2. The increase in Brinell hardness observed on the tread of different rails amounted to from 18 to 34 per cent of the original hardness number.

DISCUSSION

Commenting on the report, Herr Otto Wendt observed that the final stage of a black stain was the crumbling away or splitting off of metal usually at the running edge of the rail. He agreed that an important cause of black stains in the running surface of rails was the presence of non-metallic inclusions near the surface of the rail head, and he was concerned about the improvement of the metallurgical condition of rails. Unfavourable ingot proportions and low casting temperatures, which prevented proper deoxidation of the surface of the ingot were given as major causes of the defect. The formation of black stains might also be influenced by the presence at the edge of the top surface of the rail head of the corner structure of the original ingot ; it should be at the side of the head. Subcutaneous blow-holes breaking through under working stresses might also give rise to black stains.

FURTHER COMMENT

" Dark streaks along the top of the rail, which indicate depressed surfaces " have long been

recognised as a preliminary indication of further trouble from flow of metal or crushed heads[2]; and W. H. Sellew, in his treatise on *Steel Rails*, published in 1913, directed attention to the results of ingot segregation and to the detrimental effect of non-metallic inclusions which are potential sources of internal fissures which may extend in any direction compatible with the applied stress.[3] The German report is a well-illustrated description of effects observed, but does not reveal any very novel aspect of the subject, though it serves to direct attention to the importance of metallurgical quality. Metallurgical quality of rails in another aspect (internal flaws and the effect of hydrogen) was recently referred to by J. G. Platon[4] in a paper in which he deplores the sacrifice, to speed of production, of treatments that he considers essential to the attainment of high quality. There can be no doubt that, given suitable design and working conditions, the quality of rails is mainly dependent on the application of correct principles in manufacture.

[1] *Stahl und Eisen*, June 19, 1952, page 758.
[2] *Maintenance of Way Cyclopedia*, Simmons Boardman Publishing Company, New York, 1921, page 129.
[3] W. H. Sellew, *Steel Rails*, Constable and Co., 1913, page 392.
[4] *Revue de Metallurgie*, June, 1952, page 436.

The Influence of Rare-Earth Elements on Steel

DURING the last few years the powerful influence of the rare-earth elements on a wide variety of metallurgical products has been realised to an increasing extent. Their effect in producing a spheroidal graphite structure in cast iron, their influence in increasing the high-temperature strength of magnesium alloys, and more recently their property of conferring increased hot workability on stainless steels are all landmarks in the progress that has been made. The rare-earth elements have generally been

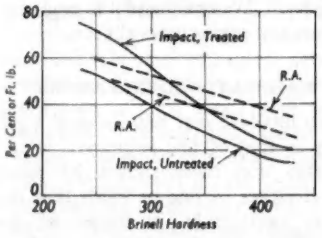


Fig. 1—Effect of Lan-cer-amp Additions (2 lb Per Ton) on the Reduction of Area and Impact Value of 0·25 Per Cent Carbon Nickel-Chromium-Molybdenum Steel, Quenched and Tempered to Different Hardness Levels (Knapp and Bolkcom)

introduced in the form of Mischmetall, the unseparated reduction product of a natural mixture of rare earths, though there are indications that the intensity of the influence of the various constituents is not the same. The isolation of these constituents is, however, a difficult and expensive business, and discrimination between the effects of the various rare-earth elements is a matter for the future, though steps in this direction have already been taken. Mischmetall contains upwards of 40 per cent of cerium, and since cerium has such a strong affinity for oxygen, nitrogen and sulphur, investigations were made over thirty years ago to test its efficiency as a "scavenger" in the iron and steel industry. The results were unpromising. The general experience was that compounds of cerium with the non-metallic elements were difficult to remove, with the result that metal to which cerium had been added was full of inclusions and hence quite unsatisfactory. As an alloying element it was found to have little or no influence on the properties of steel.

During the past year or two evidence has accumulated tending to modify these conclusions, and claims have been made that the addition of ½ lb to 6 lb of rare-earth elements per ton of ingots may greatly improve the properties of many steels. According to W. E. Knapp and W. T. Bolkcom,* Mischmetall of high lanthanum content gives the more pronounced benefit, and the American Metallurgical Products Company of Pittsburgh, Pa., have developed an alloy, containing rather more lanthanum than ordinary "Mischmetall," which is known by the trade name Lan-cer-amp. It contains 45 to 50 per cent of cerium and 30 per cent (minimum) of lanthanum, the remainder, apart from iron (1 per cent maximum), being other rare-earth metals. The effectiveness of lanthanum may be due in part to its higher boiling point, 1800 deg. Cent., that of cerium being 1400 deg. Cent.

Desulphurisation.—The desulphurising action of Lan-cer-amp has been widely confirmed. Addition of 3 lb per ton in the basic electric furnace, and 2 lb per ton in the basic open-hearth reduces the sulphur content by half. It is not

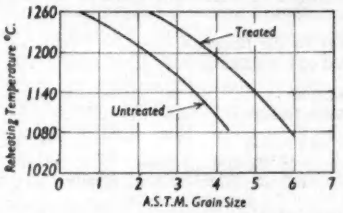


Fig. 2—Effect of Lan-cer-amp on the Grain Size of Austenitic Stainless Steel, Reheated One Hour (Knapp and Bolkcom)

generally successful in acid open-hearth steel. The major function of Lan-cer-amp is not desulphurising, but the occurrence of desulphurisation is an indication that the addition has been made under proper conditions. Some, not very detailed, reference to these is made at the end of the paper. The authors report that the additions are most effective when the steel has been made under strongly oxidising conditions, and, in basic electric practice, with minimum time under the reducing slag. In basic open-hearth practice a high lime-silica ratio, particularly on the ladle after the Lan-cer-amp has been added, is desirable. In the production of stainless steels, re-ladling gives better results than when a single ladle is used. The Lan-cer-amp is added to the second ladle and a fluid, strongly basic, synthetic slag is used for covering.

Ductility and Toughness.—Small additions of Lan-cer-amp gave consistently higher values of reduction of area and Charpy impact values. This is illustrated for a 0·25 per cent carbon nickel-chromium-molybdenum steel in Fig. 1. A similar improvement was noted in low-temperature impact values. A nickel-chromium steel bar, quenched and tempered to give a hardness of 250 gave the following results :—

	Untreated	Treated, (2 lb per ton)
Longitudinal, ft-lb	56	85
Transverse, ft-lb	36	55

In this case the transition temperature from tough to brittle fracture was lowered from −100 deg. to −150 deg. Cent.

Casting Properties.—Data supplied by G. A. Lilliequist, of American Steel Foundries Company, show a beneficial effect on the fluidity of

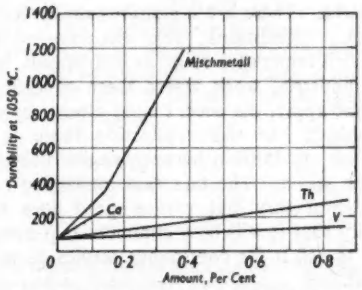


Fig. 3—Effect of Additions on the Oxidation Resistance of 35 : 20 : 45 Nickel-Chromium-Iron Alloy (Hessenbruch).

cast steel as measured in the spiral fluidity test. A reduction in tendency to hot tearing has also been reported from information obtained in a special hot tearing test.

Hot Working.—The authors confirm the previously observed improvement in the hot workability of austenitic and partially austenitic stainless steels. They also found that 2½ lb per ton of Lan-cer-amp improved the hot-working properties of stainless type 446 (a ferritic chromium steel containing carbon 0·35 per cent max. and 23 to 30 per cent chromium). The red-shortness of a special air-hardening alloy containing carbon 0·6, manganese 0·4, silicon 0·25, boron 0·5, nickel 3·0, chromium 3·0 and molybdenum 7·0 per cent, was so much improved by 4 lb of Lan-cer-amp per ton that it could be rolled easily to $\frac{7}{16}$ in diameter rod.

Effect on Grain Size.—Additions of Lan-cer-amp have been found to raise the grain-coarsening temperature by 50 deg. to 80 deg. Cent. If the explanation usually offered for grain refinement by aluminium holds, it would appear that minute refractory inclusions must be present in the molten metal to nucleate grain formation. This is possible since lanthanum and cerium both have a great affinity for oxygen and, like aluminium, form refractory oxides, of which the melting points in deg. Cent. are La_2O_3 2315, Ce_2O_3 1690, compared with Al_2O_3 2046. The grain-coarsening temperature of austenitic stainless steels is similarly affected, as illustrated by Fig. 2, which refers to type 310, containing carbon 0·25 max., chromium 24 to 26, and nickel 19 to 21 per cent. Additions of Lan-cer-amp are said, also, to restrain the grain growth and so facilitate the rolling of 2½ per cent silicon steel sheets.

Resistance to Oxidation.—Data reported by Hessenbruch are quoted to show that the presence of a very small amount of rare-earth elements has been found to improve the high-temperature oxidation resistance of chromium-nickel, chromium-iron, chromium-nickel-iron and chromium-aluminium-iron alloys. The durability, or life, at 1050 deg. Cent. of a 0·4mm diameter wire of chromium-nickel-iron and of chromium-aluminium-iron as affected by certain additional alloying elements is shown in Figs. 3 and 4. The rare-earth elements were by far the

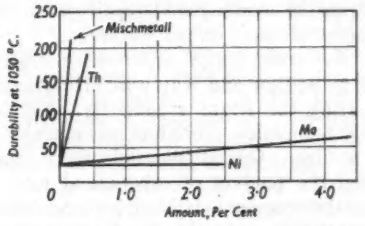


Fig. 4—Effect of Additions on the Oxidation Resistance of 30 : 5 : 65 Chromium-Aluminium-Iron Alloy (Hessenbruch)

most effective additions. The durability of the chromium-nickel-iron alloy was increased from 75 hours to 350 hours by the addition of 0·11 per cent of Mischmetall, and to 1100 hours by 0·39 per cent. A comparable effect was produced in the chromium-aluminium-iron alloy. There were also indications that constructional alloy steels treated with rare-earth elements scaled more slowly than untreated steels, and formed a thinner, more closely adherent scale.

COMMENT

In writing the article under review, the authors were concerned mainly with describing the actually observed effects of additions of Lan-cer-amp; but they added some general information about the influence of rare-earth elements which might be expected to apply also to this grade of Mischmetall. The comparative lack of success in previous attempts to make use of these elements in steel is attributed by the authors to ignorance of the proper conditions for their successful use. No theories are advanced as to why the rare-earth elements have the favourable effects recorded. The authors summarise the problem, and indicate the tendencies revealed by the preliminary results, in the hope that their statement may serve as an incentive for increased development.

CORROSION OF STEEL UNDER PHOSPHATE COATINGS.—The Iron and Steel Institute and the British Iron and Steel Research Association are organising a meeting for the discussion of papers dealing with "The Corrosion of Steel under Phosphate Coatings and Protective Finishes." It will be held at 4, Grosvenor Gardens, London, S.W.1, on Tuesday, October 28th, at 2 p.m., under the chairmanship of Mr. H. T. Shirley, who is chairman of the corrosion committee of B.I.S.R.A. Tickets for admission to the meeting can be obtained from the Secretary of the Iron and Steel Institute at 4, Grosvenor Gardens, S.W.1.

* *Iron Age*, 1952, Vol. 169, April 24th, page 129, May 1st, page 140.

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SIMPLIFICATION IN ENGINE DESIGN

There was a time, during the development of the Watt steam engine, when mishaps arising from lack of skill on the part of the operators caused James Watt to concentrate on the simplification of the engine "so as to bring its working and repair within the capacity of the average workman." Such was the crisis which arose when engines built by Boulton and Watt were first arranged for using the steam expansively, that this highly economical procedure was abandoned for a time. Operational difficulties necessitated the sending of experienced men to make the necessary rectifications. So expensive did this become that Watt—to quote his own words—"Resolved to give up the expansion of the steam until we could get men that could work it, as a few tons of coal per year was less expensive than having the work stopped. In some of the mines a few hours' stoppage was a serious matter, as it would cost the proprietor as much as £70 per hour." This was at a time when tools, materials and craftsmanship were alike inadequate. To-day, tools, materials and manufacturing techniques are developed to a level never dreamt of by Watt, and paradoxically as it may seem, this development has operated to blunt the edge of craftsmanship. Repetition methods and the clamant desire for a vast production of similar articles have combined to bring us back to the very difficulties which Watt complained of at a time when materials were at their worst and accurate machine tools non-existent. We thus find—as did Watt nearly two centuries ago—an urgent need for simplification in design, and it is something which engine manufacturers will be well advised to ponder. Simplification is not to be regarded as a retrograde step, but as something urgently to be sought after. We get a strong hint of this when passing through that impressive avenue in the Aeronautical Museum at South Kensington which illustrates, by actual examples, the progressive steps in the evolution of the aero-engine. The masses of pistons, connecting-rods, valves, springs, levers and bearings have given place to the compressor, combustion chamber and turbine. Indeed, the piston engine for high-speed military and passenger aircraft has almost gone the way of the wax candle, the horse omnibus and the fireplace.

If the internal combustion engine is to persist as an article of utility—and it has long been a tough performer—it must be so refined and simplified as to reduce the cost of its maintenance and the demand which it makes on the personnel available for servicing it. There is apt to be too much complexity and too little regard for the long-term requirements of the user. If we could contrive not only to reduce the number of types, but to render each surviving type as simple, convenient and dependable as possible, the reign of the piston engine as a prime mover would be extended. Manufacturers need to pay increasing attention to the stamina of their engines, a property that is more likely than any other to give an engine a good name. Noisy engines should be anathema and noise, in piston engines, is usually associated with excessive speed. One of the objections to engine noise is that it drowns out the evidence of impending engine trouble, and the maker of noisy engines is not promoting the interests of the industry. There are conditions of service—military conditions, for example—which render it imperative to go to high speeds, but for industrial work where these conditions do not apply, the accent must always be on durability. In this connection there is a definite relationship between engine life and piston speed. The fact that an engine can be run at very high piston speed does not signify that it will be a commercial proposition to sell it for continuous service at such speed.

More attention, we feel, should be given to the evolution of designs which, by promoting more trouble-free operation, can lessen maintenance costs. Pistons, piston-rings and bearings are apt to be the bugbears of the I.C. engine in all its forms. The fruits of actual power-house experience as well as of engine research should be applied in extending the longevity of the machine and in showing not only what is possible, but what is strictly practicable, on the long-term basis. There is apt to be a large difference between the possible and the expedient, and the designer of industrial engines has to keep his eyes on the second of these targets. He must not assume that his product will be looked after by skilled craftsmen, but rather by men who have grown up in the age of mass production. Accordingly, the greatest measure of simplicity is imperative and all possible means should be employed with a view to long, trouble-free service, thus putting the least strain on the ever-diminishing reservoir of skilled maintenance men. Expenditure incurred with the object of lessening maintenance cost will be money well spent, and in this connection it is well to remember that the real cost of a cheap engine is only known at the end of its operating life—likely to be short—when the inclusive cost of maintenance is added to the original invoice price and allowance made for excessive running expense and for losses due to outage. It is true that engine buyers have a large influence on engine design for the reason that they are too often over-concerned with first cost. What they should be concerned with are low running costs and trouble-free operation, and an engine deficient in respects so essential may be dear at any price. We began these comments by referring to some experiences recorded by James Watt. We shall end them by quoting one of the wisest sentences he ever uttered. It is as follows :—"In all things, but proverbially in mechanism, the supreme excellency is simplicity." We commend it to engine manufacturers and engine users alike.

RAILWAY "BOTTLENECKS"

In so intricate and heavily used a railway system as that of this country it is perhaps inevitable that there should be junctions, short stretches of line or yards that tend to become bottlenecks at times of intense traffic. Some arise from the geography of the neighbourhood, some from the changing flows of business with the passing of the years ; but all, singly and collectively, are a bugbear to operation and wasters of time, fuel, and direct cash, as represented by the wages of delayed train crews. We need not enlarge upon the loss of prestige to the railways that comes from late running of passenger trains, whether they result in missed business appointments, or the kind of summer reputation that once caused a distinguished hotelier at a South Coast resort to say in our hearing : "All the trains are about an hour late every Saturday." With freight trains the immediate material losses can be still greater. The "bottleneck" may take the form of a double line section on a line that is otherwise mainly four-tracked. Then the freight trains will be found queueing up, one behind the other, till a lull in the faster traffic enables one or two of them to be worked through. The same stagnation can be seen sometimes in the approach to large traffic centres where freight trains are remarshalled, or have their engines remanned, with the procession of waiting trains standing at successive block signals, or on some lines worked under permissive block rules standing buffer to buffer. Not infrequently the attitude of the enginemen of such waiting trains suggests that they have been held there for a considerable time. The result of the locomotive Interchange Trials of 1948 showed

that a delay of an hour to a heavy freight train may mean the consumption of an additional half ton of coal, and when such delays are at all regular the cost of a "bottleneck" in coal alone may be high. The problem is a serious one, partly of traffic administration and partly of engineering; but while it has been said, in very truth, that there is technically no limit to what can be achieved in the way of signalling concentration and improved control, the cost of such schemes is nowadays a vital matter.

Some forty-five years ago, when the Midland Railway was faced with freight traffic congestion so severe that sometimes trains did not turn a wheel for twelve hours or more, Sir Cecil Paget, prior to the introduction of his famous system of traffic control, instituted a campaign of sustained analytical observation of train workings at the worst trouble centres. He succeeded in cutting loose a tangle far worse than anything affecting British Railways to-day; but now the tempo of operation demanded is infinitely more exacting, the need to economise in coal is an urgent national concern, while faster and more reliably-punctual running would ultimately mean that better utilisation could be achieved from the available motive power. Already on some main lines in this country freight services have been rearranged so as to bring trains of comparable speed together into groups. The slowest and heaviest categories are run during the night, when lines are relatively clear of express passenger and perishable stock trains, and we have no doubt that a great deal more in this direction will eventually be done. This saves many delays on the open road, too frequently experienced in the past when trains of unwieldy length were being stowed into refuge sidings, and the margins in front of succeeding passenger trains were inadequate. When it comes to passenger time-table changes there is a natural reluctance to attempt anything on a very drastic scale because of the repercussions—almost unbelievable to the layman—that can be set up over half the country in the timing changes of connecting and conflicting services. But unpunctuality at holiday times leaves a bad impression on a section of the public that does not travel often and whose goodwill should be fostered, and the alternatives to time-table changes are the relatively expensive ones of increasing line capacity in the bottleneck areas by laying down additional tracks or of extensive resignalling.

A major scheme of signalling concentration, such as that put into commission at York last year, can effect a great improvement in the flow of traffic. Several other large centres, such as Crewe, Bristol, Leeds, Doncaster and Cardiff, are now equipped with full power signalling, while for freight traffic the complete remodelling of Toton up-yard, described recently in THE ENGINEER, provides an example of removing a potential source of freight train congestion. If heavy freight trains are to be run at relatively close headway in clearly defined groups the yard where remarshalling takes place must be capable of absorbing them in rapid succession so that the main lines are cleared in good time before faster trains are due. Another method, used on the electrified line between Paris and Lyons, is to signal both running lines of a double-track system for either direction working, so that in a period when the traffic is predominantly in one direction both roads can be used, and fast passenger trains run at the same time as slow freights. There is a need for the closest co-operation between all branches of the railway service concerned with running the trains. The mechanical and electrical engineer's departments are now establishing the most economical running conditions for many important classes of locomotives, and the next step would seem to be the recasting of passenger and freight train services to use these locomotives to the best advantage. This will involve analysing line, yard and station capacity and the potential savings in coal consumption, wages and locomotive availability will have to be weighed against the cost of track improvements and resignalling, and the possible effect upon traffic of time-table alterations. Railway mechanical and electrical engineers are showing what savings might be effected if the restrictions could be removed, but it will need the closest co-operation all round to make even a fraction of such savings a reality.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE LAKE MENTZ DAM

SIR,—Your South African correspondent reports (August 22, 1952) that the Lake Mentz dam has been heightened by 19ft at a cost of £800,000 to restore reservoir capacity lost through the deposition of silt over a period of thirty years.

The thought occurs that dredging might have been possible and that the cost would have been considerably less. Suction dredgers would be effective in silt deposits, although disposal of the dredged material might be difficult. Possibly it could be pumped to land upstream of the dam where it could drain. In some circumstances it might even be possible to reclaim the silt for use on the irrigated land.

As an alternative to the suction dredger there is the bucket dredger. Very large dredgers of this kind are used in Malaya for tin mining and they are capable of excavating to great depths.

Dredging equipment could be kept at work more or less continuously to prevent loss of reservoir capacity through the accumulation of silt. The heightening of the dam is only a palliative to stave off the day when the reservoir will become useless.

E. B. PARKER

Wirral, Cheshire,
September 16th.

GAS TURBINE TECHNOLOGY COURSES.—The School of Gas Turbine Technology, Farnborough Place, Farnborough, Hampshire, has now issued its programme of courses for 1952–53. These courses embrace the whole field of application of the gas turbine and they vary in duration from one to three weeks. The Design Courses, both Aero and Industrial, are of approximately post-graduate standard and are open to students of British or Commonwealth nationality. They include the running and testing of engines, together with performance calculations. The Industrial Design Courses also include specialist lectures on economics and on the use of gas turbines for Power Generation, Ship Propulsion, Land Traction and Process Plant Installations. The International Courses are for overseas students only and are a combination of the Aero and Industrial Design Courses, thus covering all applications of the gas turbine. The Practical Aero Courses, which are open to students of any nationality, are concerned principally with stripping, assembly and installation work, and do not require a high standard of academic knowledge.

Literature

Mathematics: Queen and Servant of Science. By E. T. BELL. London: G. Bell and Sons, Ltd., 6, Portugal Street, W.C.2. Price 21s.

PROFESSOR BELL, well known as the author of the series of biographical sketches in his *Men of Mathematics*, has, to produce this new book, revised and amplified two other earlier works, *The Queen of the Sciences* and *The Handmaiden of the Sciences*, which originally appeared in 1931 and 1937 respectively. The description of mathematics as the "Queen of the Sciences" is attributed to Gauss. Professor Bell uses it as a title for that part of mathematics which proceeds aloof and untrammelled by practical considerations of the other sciences, but rendering assistance to them from time to time. The reason for the description of mathematics as the handmaiden or servant of science is obvious. This title is used for that part of mathematics directly harnessed to the service of the sciences. These personifications stand, very roughly, for pure and applied mathematics. They are not, however, two distinct subjects and the author has stressed their inseparability. No attempt has been made to produce a consecutive narrative, but rather a selection of topics has been made from the vast field of the history, achievements and problems of mathematics. The selection is diverse.

For the engineer no doubt the most familiar part of the book is the account given of "The Chief Instrument of Applied Mathematics," the calculus, and the ensuing chapter on "Waves and Vibrations." In the latter the reader is led by a "painless path" to Maxwell's wave equations. This topic is considered elsewhere in the book as an example of prediction, as illustrated by the manner in which Hertz in 1888 was led to the discovery of wireless waves twenty-four years after the publication of Maxwell's equations. Other examples of prophecy are considered, including that of the existence of the planet Neptune. This is cited as a mathematical achievement following a long train of events which started with the discovery of conic sections by Menaechmus (*circa* 350 B.C.), takes in the formulation of Kepler's laws and the propounding of Newton's law of universal gravitation, and concludes with the calculations of Adams and Leverrier, from these laws, of the reason for the perturbation of the planet Uranus.

Another example of astronomical prediction is recounted, the calculation of the advance in the perihelion of the planet Mercury, which was one of the classic vindications of Einstein's general theory of relativity. One may perhaps quarrel with the author's discussion of Einstein and relativity before dealing with Newton and gravitation. But the former is made to follow a discourse on geometry from Pythagoras to Riemann by way of Descartes. This topic affords a good illustration of assistance being given by the "Queen."

Within the realm of the "Queen of the Sciences" selections have been made from all the branches of pure mathematics. There is to be found something of the algebra of Gauss and Boole, the analysis of Weierstrass and Dedekind, topology and the theory of groups. Special attention is given to the "Queen of Mathematics," arithmetic or the theory of numbers. For many readers this will be probably the least familiar part of the book, but it is likely to be the most interesting. Results are recounted which have occupied the attention of mathematicians for over 2000 years, and many problems are quoted, such

as the proof of Fermat's last theorem, which to this day defy solution.

There is meat for the philosopher in the many contentious issues which are debated, including "Is Probability Probable?" and "What is a Number?" and the very existence of mathematics is discussed.

Professor Bell is a master of clear exposition and makes even the most abstruse passages understandable. He intermingles with mathematics short biographical notes, anecdotes and humorous epigrams. It is not to his detriment, but the reverse, to describe his style as racy and entertaining. A detailed contents, a good cross reference system, an index of names and a general index all help to produce a most readable book. No high mathematical accomplishments are needed for its enjoyment and it is unreservedly recommended.

Three Hundred Years on London River, The Hay's Wharf Story, 1651–1951. By AYTOUN ELLIS. London: The Bodley Head, 28, Little Russell Street, W.C.1. Price 30s.

THE history of London has been enriched by this book, which tells not only the story of Hay's Wharf, known as London's larder, covering the last three hundred years, but has gone much further into the past to discover the origin of place names and surnames. In the course of such research much that is of interest concerning the neighbourhood of Hay's Wharf has come to light and appears in the volume, including a note to the effect that the name of Hay was recorded as early as the fourteenth century. In particular, this study of the romantic rise of one of the oldest commercial undertakings on London's river makes a direct appeal to those interested in its shipping and commerce, giving, as it does, an account of the development of warehousing and also of the families who have contributed so much to the prosperity of London. Historic Southwark and Bermondsey, with their links with Chaucer and Dickens, form the background of the story into which is interwoven the separate stories of the historical associations of a particular site or street. There is an account of the Church of St. Olave, with its Norwegian associations, which had existed for a thousand years on the site where Hay's Wharf's head office now stands; the wharf itself stands on the site of the town house of the Abbot of Battle. The Hibernia wharves have, built into the fabric of one of the warehouses, part of the walls of Winchester Palace, and the Clink, the name of the palace private prison, is now a generic term for prisons. The story opens with the brewer, Alexander Hay, acquiring an interest in Pipe Borers Wharf, where waterpipes were bored out of elm trunks for the New River Company. With wooden warehouses the considerable risk of fire caused Joseph Hay and other wharfingers to found the first fire insurance society, "Ye Amicable Contributors," for the mutual sharing of fire risks. The last of the family to be a proprietor of Hay's Wharf was Frances Theodore Hay, who died in 1838, and the name of Humphery became more prominently associated with the undertaking, while the Hay family turned to barge building. After the fire of 1861, Alderman Humphery, who had developed other wharves, took in as a partner the Smith family of bankers, and the business was styled "The Proprietors of Hay's Wharf," by which name it has continued to be known. The book records the expansion of the business to meet the rapidly changing conditions of world commerce. This meant augmenting coastal trading with a share of ocean-going traffic and saw the appearance of the China Tea Clippers at the wharf and the development of trade with the Empire, especially Australia and New Zealand. Although the story is mainly historical, the modern buildings and equipment of Hay's Wharf include the latest examples of engineering development in cargo handling and cold storage. Many reproductions of oil paintings, old prints, maps and documents appear among the pages of the book and they add greatly to the interest of the Hay's Wharf Story.

SHORT NOTICES

Wireless Fundamentals. By E. Armitage, M.A. (Cantab), B.Sc. (London). London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 18s.—There are many books on wireless, suitable for students of University standard with a knowledge of calculus and a leaning towards a mathematical approach to the subject; there are other books written for beginners with no previous knowledge of electricity. The book under review is designed to bridge the gap between these two classes. It should appeal to those who find the advanced books too mathematical and the simpler books too elementary. Accordingly, the author has assumed that the reader will have a knowledge of elementary electricity up to Ohm's Law, he has avoided the use of the calculus, but has emphasised the physical and experimental side of the subject. However, to complete the presentation, the necessary mathematical analysis is given separately in appendices. The book covers the fundamentals of wireless from the diode and triode valves to the principles of the superheterodyne circuit, the author's intention being to give a more detailed treatment of the superheterodyne and matters of sensitivity, selectivity and fidelity in a subsequent volume.

Kilmarnock Firm's Centenary

A LUNCHEON to celebrate the centenary of Glenfield and Kennedy, Ltd., was held at Kilmarnock on September 19th. The present company has grown from two earlier companies, one of which originated as the Kennedy Water Meter Syndicate in 1852. The syndicate was formed to exploit Mr. Thomas Kennedy's invention of the water meter, by himself and three partners, and in 1863 it was converted into a private company with the title of Kennedy's Patent Water Meter Company, Ltd. The Glenfield Company, Ltd., was formed in 1865; it was founded by the same individuals who formed the earlier company, and the two concerns had their managements in common. From 1870 their workshops were adjoining, but until comparatively recent years what was known as the "meter works" confined itself to the manufacture of Kennedy meters and was regarded as a separate works, all other developments being originally the responsibility of the Glenfield Company. Now, however, the meter works has become a department of the works as a whole. The limited liability company of Glenfield and Kennedy, Ltd., was formed in 1899.

The Kennedy meter was introduced at a time when piped water supplies were beginning to be provided for cities and towns and it was adopted in all parts of the world. It had a long life and it is not uncommon, the company point outs, for meters which have been in operation for fifty years and more to be returned to the works for overhaul. One manufactured in 1858 was overhauled in 1937 and is still in operation. For many of its original applications the Kennedy meter has been superseded by lighter and less expensive but less accurate instruments, but it is still extensively used for the measurement of boiler feed water and oil, where accuracy is a necessary attribute.

The company's interest in the manufacture of sluice valves came about almost by chance. One of its overseas customers for water meters had been disappointed by its suppliers of valves and it was suggested to the firm that it might care to take over the contract. This was agreed to and the first sluice valves, of 3in diameter, were made in 1867. From that time sluice valves have formed an increasingly large proportion of the output of the works, and the sizes in which they were made became progressively larger. Sluice valves now form a major part of the production of the works as a whole, and sizes up to 10ft diameter have been made.

In the few decades before the advent of the electric motor, when industry in Britain was rapidly expanding, the need to replace the work of men by power-driven machines led to the extensive development of water power. The company played an important part in designing and constructing a wide variety of hydraulic machines, pumping plant, weight loaded accumulators and piping to serve this need, but with the introduction of the electric motor and the extension of public electricity supplies the types of hydraulic machine in which the company specialised were superseded.

The pioneers of the Glenfield Company, having established themselves in the waterworks world through the supply of meters and sluice valves, extended their interests by undertaking the design, manufacture and installation of pumps and steam engines. This part of the company's business was abandoned when the centrifugal pump was introduced and the company decided to devote its capacity to the specialised production of valves and water control equipment in general. However, the services of the company for the production both of heavy hydraulic machinery and steam engines were used during the last war for producing cordite extrusion presses, chill forging presses, and triple expansion engines for marine propulsion.

The company now devotes itself almost exclusively to the design and construction of equipment for the control of liquids including water, oil and chemicals. It serves practically every industry, but the major proportion of its production is directed to water supply schemes, hydro-electric developments, oil refinery installations, steam power stations and irrigation projects. The range of valves manufactured is comprehensive and also covers the whole field of sluice gate construction for the control of flood discharge from reservoirs and impounding barrages in rivers. Some recent developments which the company have introduced include the microstrainer (THE ENGINEER, September 9, 1949) and the hydraulic elevation fish pass (THE ENGINEER, April 1, 1949). Many of its recent installations have been described in these columns from time to time.

The works at Kilmarnock are built on a 40 acre site and the workshops cover an area of 16 acres. The workshops are self-contained and comprise a patternshop, iron foundries, brass foundries, and engineering shops. An account of a recent modernisation scheme at these works was given in our issue of June 11th, 1948. The number of employees is at present 2500, having increased by 50 per cent during the past twenty-five years.

At the firm's centenary luncheon an address of welcome to the guests was delivered by the chairman of the company, Mr. H. Cowan Douglas, and toasts of "Glenfield and Kennedy, Ltd.," and "Scottish Industry" were proposed by Lord Bilsland and the Earl of Horne, respectively. We understand that the firm's celebrations include generous provision for all the staff and workers. A volume entitled *The First Hundred Years* has been published to mark the centenary: it describes the products manufactured by the firm, the historical and personal aspects of its development having already been described in *A Romance of Industrial Engineering*, by J. A. Morris.

NEW HIGH-SPEED DIESEL ENGINE.—The Caterpillar Tractor Company announces that a new high-speed diesel engine is now in production under the mark "D.326." The engine has six cylinders of 5¼in bore by 6in stroke and is available as an industrial power unit having an intermittent output rating of 170 h.p. at 2000 r.p.m.; a generator set with a twelve-hour rated output of 80kW; and a marine engine with a continuous rating of 118 h.p. at 1600 r.p.m.

The Commercial Motor Show

No. 1

THE Commercial Motor Transport Exhibition was first held at the Crystal Palace, London, in 1907, five years after the Society of Motor Manufacturers and Traders was formed. Since then it has been held biennially (except for the war years), and this autumn the exhibition coincides with the golden jubilee of its organisers. In 1907 some 25,000 visitors attended this Show, a number which had grown to 117,000 in 1950, and is likely to be surpassed this year.

The exhibition, which is being opened to-day, Friday, September 26th, at the Earls Court Exhibition Hall, includes a display of vehicles—goods and passenger carrying—tractors and trailers for loads up to 60 tons. In all 433 commercial vehicles are on show,

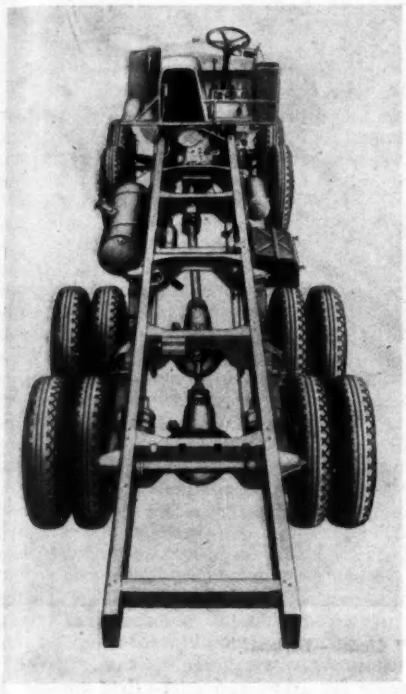


Fig. 1—" Mammoth Major " Mk. III Eight-Wheeler—A.E.C.

together with a comprehensive range of allied motor products, and a number of new models are exhibited for the first time.

In this connection it is well to remember that in the last seven years manufacturers of commercial vehicles have made impressive headway in both production and export. Output of buses, lorries, tractors and vans, now running at the annual rate of about 250,000 units, is, in fact, more than twice the pre-war level, while exports have increased sevenfold.

All through the post-war period motor manufacturers have suffered from lack of sufficient raw material, in particular from the steel shortage, which resulted at the beginning of this year in the introduction of a general steel authorisation scheme. Rearmament, which is still largely in the preparatory " tooling-up " phase, so far has had little influence upon the civil production programme. The output of commercial vehicles for the first half of this year was 124,820, that is only 10,000 units lower than last year's figure. Export figures of commercial vehicles, however, brought the aggregate for six months to 72,840, valued at £41·9 million ; the corresponding figures for last year were 70,375 at £33·8 million. From these figures it is clear that the prosperity of the commercial vehicle industry, the volume of which is appreciably larger than in pre-war days, depends greatly on the export trade, as the home market is unable to absorb all that industry can produce.

Up to now British manufacturers of commercial vehicles have met considerably less competition from Continental manufacturers in overseas markets than the manufacturers of motor-cars. Nevertheless, the industry has made great efforts to forestall any criticisms which are likely to be raised against British commercial vehicles in foreign markets. Tests and trials are being carried out continually, both at home and overseas, to meet even the most severe operating conditions. The development of the M.I.R.A. proving ground near Nuneaton, on a co-operative basis, with its corrugated roads, dust tunnels and other test facilities, has greatly assisted in this respect. It can be said without exaggeration that the British commercial vehicle industry of to-day owes its reputation not to any artificial advantages, such as dollar shortage or other currency restrictions, but to the high standard of its products. British diesel engines in particular, with their high economy, reliability and longevity, have been able to compete on better than level terms with foreign competitors.

In the home market one of the main problems in transport to-day is the cost of operation. Throughout the world the price of fuel has reached exorbitant figures. In consequence, fares and freight charges have gone up to such an extent that any further increase may defeat its object by causing diminishing returns. The industry has tried, and, as many exhibits at the Show prove, quite successfully, to overcome this problem by lighter chassis construction, as well as of bodies without sacrificing strength. The employment of light metal parts for the chassis and improved designs of passenger vehicle bodies, entirely or to a greater part built of aluminium alloy, has become more frequent with the result that in some cases fuel consumption is 20 per cent less than that of pre-war models.

Apart from the general tendency to reduce the weight of the vehicles, another trend to be observed is the increase of underfloor engines, of which type some new models are making their first appearance at the Show. This development, so far, seems to be mainly confined to passenger vehicles, as the operators of goods vehicles, rightly or wrongly, are still doubtful as to whether this type of engine, with its comparatively low ground clearance, will stand up to rough treatment and operating conditions quite so well as the orthodox vertical engine.

The industry, furthermore, has taken greater care than hitherto to improve the drivers' comfort, thus reducing fatigue and accidents resulting therefrom by improved interior fittings, heating and ventilation, and by a sensible arrangement of the instruments. In the heavier vehicles great ingenuity has been employed to facilitate the operation of the clutch and gear change to assist braking and, in some cases, steering by some servo mechanisms. The following report covers a selection of vehicles of new or improved designs in order to give a general impression of the size and scope of the exhibition and to illustrate the present trend of development.

The A.C.V. Group of Companies, comprising A.E.C., Crossley Motors and Maudslay Motor Company, is exhibiting many types of vehicles, the passenger range including single-deckers with vertical and underfloor engines and double-deckers. The goods models shown are home and overseas versions of the four, six and eight-wheeled designs.

Among the heavy vehicles there is an overseas version of the A.E.C. " Mammoth Major " Mark 3 eight-wheeler, designed for 22–25 tons gross loads (Fig. 1). It is a left-hand control, 18ft 9½in wheelbase chassis, fitted with a 150 b.h.p., 11·3-litre, direct-injection diesel engine. An important detail to overseas operators is that, in common with all other A.E.C. left-hand control chassis, all auxiliaries are mounted on the right-hand side of the engine, so as to be accessible when the bonnet is opened.

The gearbox is of the five-speed constant-mesh design. Again in keeping with the special requirements of overseas, where vehicles frequently have to operate over rough terrain, this model is shown with a fully articulated rear bogie, which is available as an alternative to the standard balanced beam system of rear suspension. The double-drive rear axles incorporate overhead worm drives and a third differential which balances the drive to the rear axles and

Fig. 2—The " Regal " Airline Bus—A.E.C.

is attached to the rear end of the worm casing of the first axle. The front axle is of a design similar to that fitted in A.C.V. passenger models, and particular care has been taken to ensure a high degree of centre-point steering, so eliminating driving fatigue.

A " Regal " Mark IV underfloor-engined passenger model is shown at the stand of Crossley Motors, Ltd. This model is powered by an A.E.C. 9·6-litre horizontal oil engine developing 120–125 b.h.p. in " floating power " rubber mountings. Built-in lifting gear permits the easy removal and replacement of the engine. Transmission is through a fluid flywheel and four-speed air-operated preselected gearbox or, alternatively, through a hydraulically operated friction clutch and a four-speed synchromesh gearbox. The chassis frame of the " Regal " Mark IV is of alloy steel channel section and cross-braced by channel section cross members. The vehicle is made either as a 16ft 4in wheelbase model with fluid transmission for home use or for overseas use with a wheelbase of 17ft 6in.

The " Mandator " Mark III four-wheel chassis on the A.E.C. stand is designed for gross loads up to 22 tons with a trailer or semi-trailer. This model has left-hand control for overseas use and is fitted with the A.E.C. 11·3-litre oil engine. The drive is transmitted through a single dry-plate clutch and a unit-mounted five-speed and reverse gearbox with constant mesh in the second, third and fourth speeds. The rear axle is of the double-reduction principle, having a primary reduction by spiral bevel and pinion and a secondary reduction by double helical pinion and gear. The half-shafts are fully floating and the wheel hubs are carried on large taper roller bearings. Compressed air brakes are fitted, the air being supplied by a single-cylinder compressor driven from the gearbox layshaft.

An interesting coach, specially designed for airline work, is to be seen on a " Regal " Mark IV underfloor engine chassis (Fig. 2). The bodywork, made by the Park Royal Vehicles, Ltd., is of integral construction. Pillars of extruded aluminium alloy are solidly riveted directly to the chassis outriggers, and aluminium alloy is also extensively employed in the truss panelling. All exterior panels are of aluminium sheet, secured to the pillars by hollow rivets. The adoption of this method of attachment greatly facilitates the removal and replacement of panelling, which may be damaged through accident and also provides ready accessibility to the main structure for maintenance and inspection.

It seats thirty-seven passengers on two levels, the lower and forward saloon accommodating sixteen and the higher rear saloon, reached by a short three-step stairway, seating twenty-one. The design of this coach caters most adequately for getting passengers and their baggage from town to airport quickly and comfortably ; an extremely large luggage department is arranged at the rear of the vehicle, placed beneath the floor of the raised rear passenger level, and further hatches are provided in the body side.

On the stand of Scammell Lorries, Ltd., the six-wheel drive " Constructor " attracts much interest. This entirely new vehicle has been designed for 30–100 tons gross, according to the application, and to give maximum highway or cross-country performance whilst retaining the advantages of normal dimensions. The six-wheel drive and a high degree of articulation of the rear bogie provide a good cross-country performance, while the power-assisted steering facilitates control even under severe conditions.

The vehicle is powered by a six-cylinder Rolls-Royce oil engine, which develops 155 b.h.p. at 1800 r.p.m. and has its maximum torque of 500 lb-ft at 1200 r.p.m. In order to ensure satisfactory operation in tropical climates the engine is fitted with a built-in oil cooler and has a large-capacity radiator.

The independently mounted six-speed constant-mesh gearbox incorporates a 1·6 : 1 overdrive and, in conjunction with a two-speed transfer box, provides twelve forward speeds and two reverse. The front wheel drive can be disengaged either when moving or stationary ; a power take-off transmits the full torque of the engine in all gearbox ratios. The rear bogie and the suspension is located by torque arms and radius links, thus relieving the springs of all driving and brake reactions or twisting effects. A vertical spindle winch accommodates 450ft of rope and gives a pull of 33,600 lb ; it has a tension-limiting device and a mechanical serving gear, by which the laying of rope is controlled.

The " Constructor " can be supplied either as a rigid load carrier, as a tractor for use with a superimposed semi-trailer, or as a tractor for drawbar trailers. It is available with a number of wheelbases to meet many specialised haulage requirements.

On the stand of Transport Equipment (Thornycroft), Ltd., a new chassis, the " Nippy Star," is shown, which can be considered the successor to the original " Nippy " 3-ton vehicle. Several improvements have been introduced into this range for which, the gross laden weight has been increased to 6¼ tons, thereby allowing a full 4-ton payload to be carried on a platform or in a hinge-sided body of normal construction. Very noticeable is the improved appearance achieved by the metal cab base with the mudguards and engine bonnet in unit construction. An external radiator filler cap allows " topping-up " of the radiator to be carried out easier and quicker than hitherto, and the new position for carrying the battery on the side of the frame gives improved accessibility.

Other improvements are the fitting of a draught-proof sub-assembly of the clutch, brake and accelerator panels in the driver's cab. Larger brake lining areas are used in the two leading shoe brakes, and the rear road springs are now of the progressive design, resulting in smoother riding under varying load conditions.

Among other exhibits at this stand is a 6 by 4 right-hand-drive chassis, which in many respects is based upon the original six-wheeled goods vehicle supplied to the South African Railways in large numbers. This chassis is fitted with a new 11·3-litre oil engine, which develops 150 b.h.p. at 2000 r.p.m. Main features of this chassis include a four-speed main gearbox and a three-speed auxiliary gearbox, incorporating an overdrive, twin worm driven rear axles and air pressure brakes. This chassis is designed for a gross laden weight with trailer of 35 tons.

One of the major attractions of the Show is a new underfloor diesel-engined forty-four-seater bus chassis by Leyland Motors, Ltd., which weighs only 3¾ tons, and is primarily meant for urban and inter-urban services at home. This chassis, known as the " Tiger Cub," more than substantiates the rule-of-thumb method of estimating fuel consumption, namely, that a decrease of 1 ton in the weight of a bus will result in an approximate saving of 1 mile per gallon of fuel. Well-known body builders have collaborated with Leyland, to produce bodies specially for this model. Saunders-Roe, Ltd., and Metropolitan-Cammell-Weymann Motor Bodies, Ltd., have each provided a forty-four-seater front-entrance service bus body which gives a complete vehicle weight below 6 tons, thus ensuring a gross vehicle weight of less than 9 tons.

The saving of weight in this model is the more remarkable, as it has been accomplished without any reduction of the overall dimensions of the transmission. The 16½in diameter clutch is the standard clutch unit used on all Leyland heavy-duty goods and passenger vehicles, and the gearbox, as well as the propeller shaft, and the universal joints were originally designed for heavy duty in double-deck buses.

The 90 b.h.p. diesel engine fitted in the " Tiger Cub " is a horizontal version of the 5·76-litre vertical unit, which has given good service in the Leyland " Comet 90 " cruiser-weight range of trucks. The four-

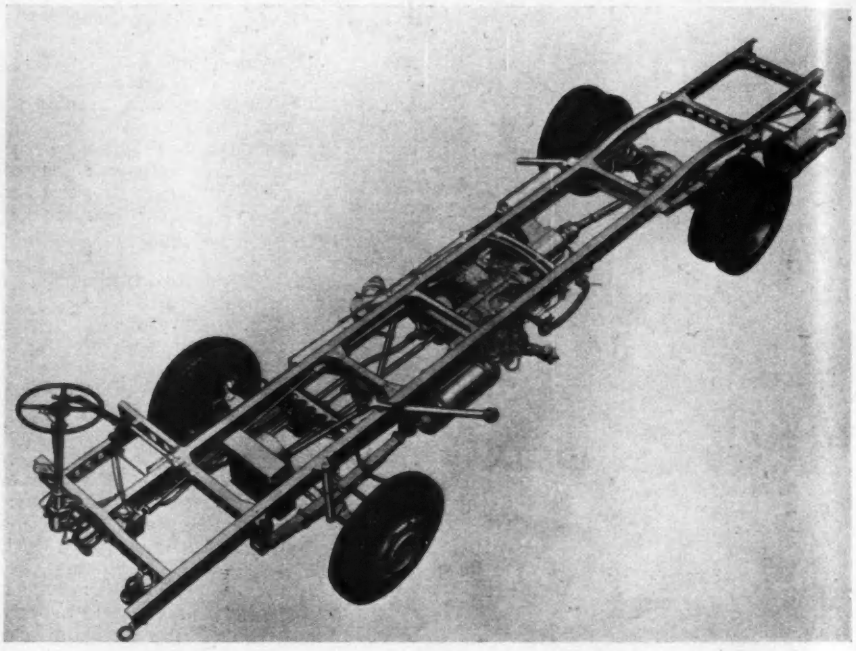


Fig. 3—The " Tiger Cub " Chassis—Leyland

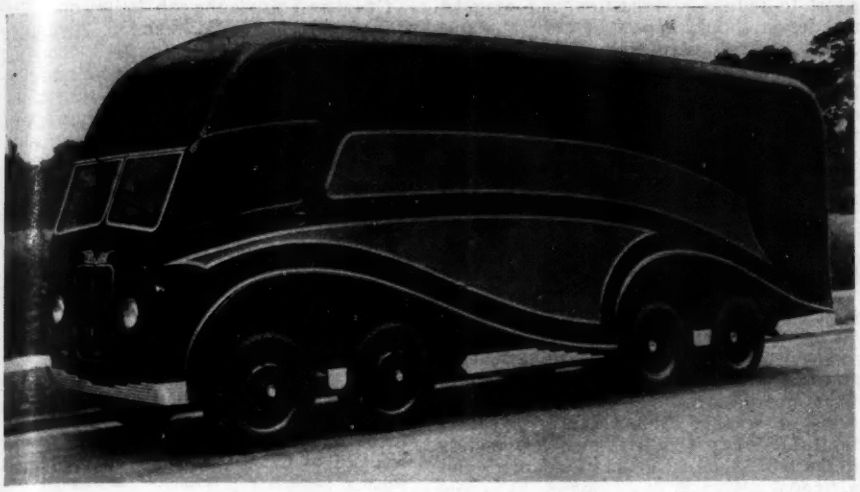


Fig. 4—The " Octopus " Van—Leyland

speed gearbox has constant mesh for top, third and second speed gears, the engagement being effected by dog clutches. All gears are of the single helical type. Light tubular shafts with universal joints couple the gearbox selector mechanism to the gear lever, which is at the driver's left-hand side.

The frame has a width of only 34in and consists of parallel side members tapering in depth at the front and rear. The narrowness of the frame has allowed the designer to outrig the spring anchor brackets, which gives the additional advantage of reducing the height of the frame. On the right-hand side, where the frame member narrows at the mid-section to allow clearance for the engine, the member is reinforced with a length of channel section. The only outrigging of members is at the front to provide support for the hand brake and peddle gear.

A 24-gallon fuel tank is slung on the frame rear overhang on the left-hand side. The reduction in capacity, as compared with other Leyland passenger vehicles, is justified on the ground of weight reduction and also because of the vehicle's low fuel consumption, which makes a full tank being more than adequate for a full day's operation.

Steering and springing are conventional. The box holding the Marles cam and double roller steering is rigidly mounted on the foremost cross member, and orthodox layout is used for track rod and drag link. To increase resistance to fatigue the tension side and the edges of the top spring leaves are shot peened. Hydraulic shock absorbers at the front control suspension on bump and rebound. Fig. 3 shows the layout of the chassis. More details concerning the engine, clutch, rear axle, and the air pressure braking system will be described in a later paragraph dealing with items of special interest.

Another impressive vehicle to be seen at the Leyland stand was the eight-wheeled " Octopus " with a body built by Thomas Allsop, Ltd., having a capacity of 1350 cubic feet (Fig. 4).

The chassis, powered by 125 b.h.p. diesel engine, has a wheelbase of 17ft 9in. The torque is transmitted through a single dry-plate clutch to a five-speed gearbox and through two open tubular propeller shafts to the double-drive rear bogie. The bogie consists of two identical rear axles, with a reduction ratio of 7·33 : 1, which are coupled together and driven by a short Hardy-Spicer universal-jointed propeller shaft.

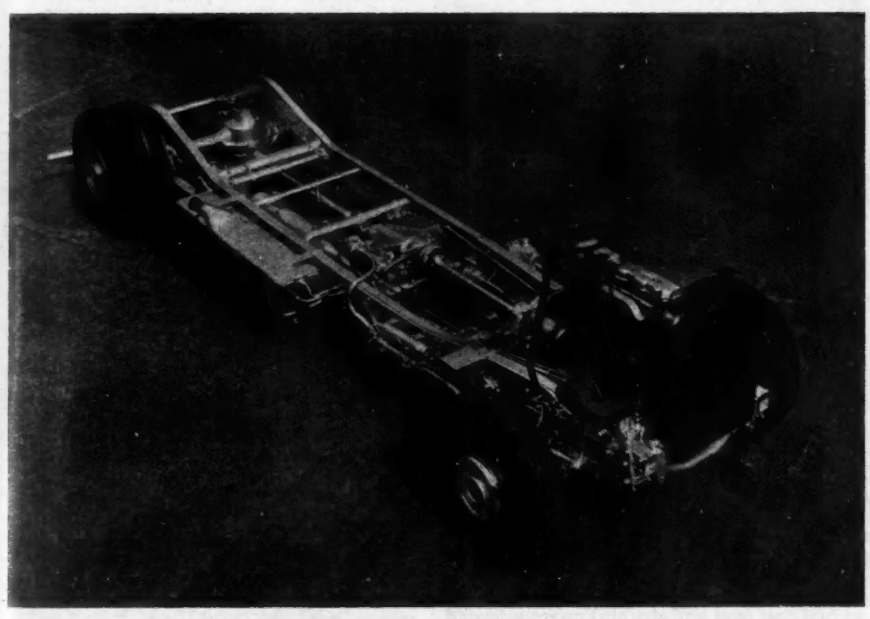


Fig. 5—" Lightweight " Double-Deck Passenger Chassis—Daimler

The axles are attached by swivelling trunnions to the ends of the inverted semi-elliptic springs, which are mounted on trunnion brackets, supported by a tubular cross member which passes through large brackets secured to the frame.

The steering control of the second axle of this eight-wheeled chassis is effected by a connection from the steering drop arm to a relay lever pivoted on the frame midway between the axles and thence to the steering arm of the second axle.

The cab and van are built integrally. The wooden floor of the van rests on the chassis frame on timber cross bearers, and has a clear flat length of 24ft, uninterrupted by wheel arches. The overall height of the van is 11ft 9in, giving an inside height of 8ft.

Among the exhibits of Transport Vehicles (Daimler), Ltd., an interesting vehicle is the " Freeline " underfloor engine passenger chassis powered by a 10·6-litre engine with left-hand drive and power-assisted steering. The latter equipment is optional for long wheelbase chassis operating in difficult overseas conditions. The assistance to the steering effort is given by a hydraulic cylinder embodied in the steering column. Pressure fluid is derived from a Lockheed continuous-flow system with accumulators and a charging valve which is fitted to the " Freeline " chassis as standard for brake operation and gear change. The system can also be tapped off for hydraulic operation of the doors in the body of the vehicle. Another non-standard detail of this chassis is a mileage controlled automatic chassis lubrication system.

Improvements incorporated in the " Freeline " since its introduction last year include a hydraulic gear change operated by a cylinder mounted on the side of the gearbox. Also available are four-speed gearboxes as an alternative to the standard five-speed gearbox.

An entirely new chassis is the Daimler " CLG 5 " lightweight double-deck chassis of 6ft 4in wheelbase, powered by a Gardner 7·0-litre diesel engine. The chassis is the outcome of investigation into weight reduction in the interest of economical running, carried out by Daimler in response to suggestions from many municipal operators. The Aluminium Development Association has played an important part in this project and consequently extensive use has been made of light alloys for the various parts of the chassis. The aim has been to produce a double-deck vehicle with a normal capacity of fifty-four to fifty-six passengers and a gross weight of 10½ tons, as against the average present-day weight of 11½ tons for a vehicle of this type and capacity. In pursuance of this aim it was decided that the total required saving of weight would be divided equally between chassis and body, entailing a saving of 10 cwt in each.

The chassis has a wheelbase of 16ft 4in and is designed for a fifty-six-seat body, 7ft 6in wide and 27ft long. In order to suit all operational requirements it is arranged to accommodate any of three power units : the Gardner five-cylinder, 7·0-litre ; the Gardner six-cylinder, 8·4-litre ; or the Daimler six-cylinder, 8·6-litre oil engine. Engine mounting is by means of four " Metalastik " mountings, the difference in the lengths of the engines being accommodated by varying the length of two mounting arms which are bolted to the flywheel housing at the rear of the engine. By this means the necessity for varying the position of the cross members carrying the power unit is avoided.

When fitted with the Daimler engine the chassis will be known as the " CLD Light-

weight." Development is now proceeding in order to reduce the weight of this Daimler 8·6-litre engine by the use of light alloy parts in place of some of those previously manufactured in other metals, and it is expected that the weight of the complete chassis will be the same when fitted with either the Daimler or the Gardner six-cylinder engine.

In spite of the tendency of saving weight wherever possible, the chassis side members are similar to those used in the well-known "CD 650" chassis, there being no reduction in dimensions or weight of the channel sections for reinforcements. The side members, however, are 1½in closer together than in the "CD 650." This reduces the length and weight of the cross members, which are further lightened by employing integral flanges in place of heavier welded brackets in all except those which support the engine at the front and the gearbox at the rear.

Light alloys have been used in the chassis wherever their light weight is compatible with the required strength; for instance, for the spring brackets, the mountings for engine and gearbox, the steering box, the radiator (for which aluminium alloy is used in place of gunmetal), and for all water connections. The gearbox casing is in "Electron" and the final drive worm shaft assembly casing is in aluminium.

The braking system is the same as that used in the Daimler "Freeline" chassis. It is the Lockheed "continuous flow" system, actuated by a hydraulic pump, mounted on the inside of one of the chassis frame side members and driven by a twin vee belt from a pulley at the front of the gearbox.

The transmission system has the usual open-circuit fluid flywheel and a four-speed pre-selective epicyclic gearbox. The final drive is by a fully floating underslung worm drive offset to the left.

The exhaust pipes and the silencer are suspended from small flexible mountings fitted to the chassis frame members, thus allowing the exhaust system to move without damage from vibration or engine oscillation.

The tendency of reducing chassis weight is also apparent in two new models seen at the stand of Dennis Bros., Ltd., both underfloor vehicles, the "Lancet" and the "Stork."

The "Lancet" illustrates a determined effort to reduce complication and weight; the design should appeal to both bus and coach operators, particularly by virtue of the straight parallel frame members and the low front platform. The chassis has a six-cylinder, 7·6-litre diesel engine of the manufacturer's own make, which develops 110 b.h.p. at 2000 r.p.m. The drive is transmitted to a five-speed gearbox with a pre-selected overdrive fifth gear working through a dry two-plate clutch with hydraulic control. The heavy frame with outriggers permits either stressed skin or conventional body construction. The brake system is of the "constant-flow" hydraulic design with an accumulator.

The Dennis "Stork" is a 3-ton delivery van fitted with a Perkins horizontal underfloor engine developing 52 b.h.p. at 2400 r.p.m. A straight frame with drop extension for the driver's platform gives low ingress to the cab. The gearbox has four speeds and a hypoid rear axle is employed. The low floor level makes the vehicle particularly attractive for travelling shop or delivery applications. The wheelbase is 11ft 8in, the overall width 6ft 6in.

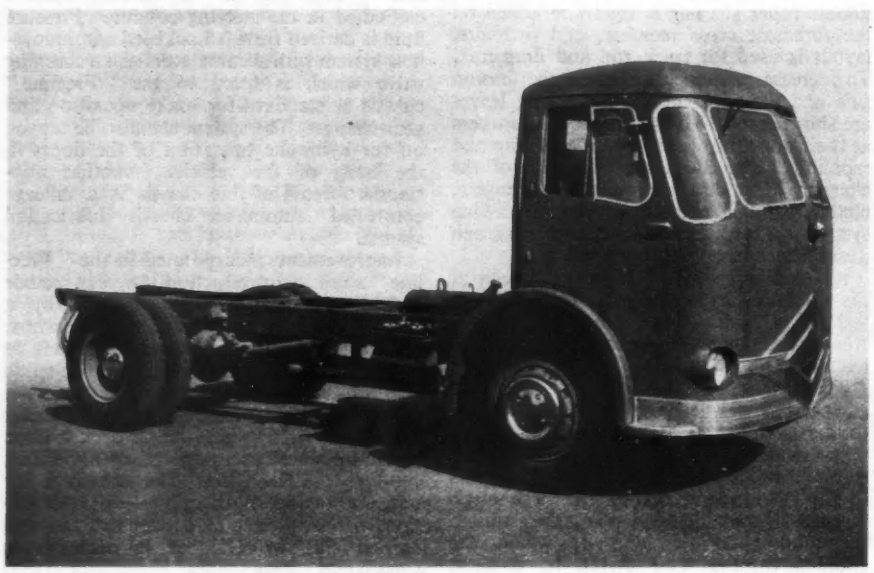


Fig. 6—8-Ton Chassis and Cab—Foden

Another new vehicle which has been built to meet the demand for a lightweight truck to carry an 8-ton payload in this country is the Foden "FE.4/8" truck (Fig. 6). The unladen weight of this vehicle is approximately 3½ tons and the maximum gross laden weight in this country is 12 tons. For service abroad the gross laden weight is reduced to 10½ tons, giving a payload of 7 tons. The vehicle is of particular interest, as it is the only one at the Show powered by a four-cylinder two-stroke engine, which, with a capacity of 2·7 litres only, develops 84 b.h.p. at 2000 r.p.m. Another interesting part of this truck is the gearbox, which, together with the engine, will be described in a later part of this article.

The torque is transmitted from the gearbox to the hypoid rear axle through a propeller shaft with needle roller bearings and an intermediate shaft. The intermediate ball bearing is pivoted on two rubber bushes attached to the cross member. The rear axle casing is a steel forging, as are the front and rear wheel hubs, which are carried on taper roller bearings. The brake drums are of special cast iron and the brakes are actuated by the Lockheed system, servo-assisted by a hydraulic booster.

Of interest also is the cab design, on which special care has been taken to give easy entrance. The engine casing is reduced as much as possible and the controls are so arranged that there is a floor across the vehicle forward of the engine, making access to the driver's seat possible from either side.

(*To be continued*)

British Overseas Airways Corporation

THE annual report and accounts for the year ended March 31, 1952, of the British Overseas Airways Corporation has now been published. It notes that for the first time a profit amounting to £1,233,722 was made by the Corporation, of which £274,999 was net surplus. Other items in the financial report show that the total revenue increased to £33,567,862 from £24,252,115, of which passenger revenue amounted to £19,680,109, and the report notes that the operating cost in pence per capacity ton-mile has been reduced from 39·5. to 38·8 A vital economic factor also was the increase in the load factor achieved, which was raised from 59·5 per cent to 65·7 per cent on a capacity which had itself been increased by 20 per cent. The Corporation carried over a quarter million passengers, 6031 tons of freight and 2895 tons of mail.

The report next reviews the drastic programme of reorganisation affecting personnel, bases and aircraft, which had been in hand for the last four years. It is recorded that, of a total fleet of 137 aircraft in 1948, only six were basically designed and suited for the long-range character of the Corporation's business. It was forced to employ as many as nine types of aircraft and was using no fewer than eight maintenance bases. The average block-to-block speed with these improvised machines was only 186 m.p.h., their average payload capacity was only 3 tons, and average seating capacity was nineteen. Now the Corporation has only five types of aircraft in service, the report continues, and is using only two major maintenance bases; its aircraft operate with an average block-to-block speed of 225 m.p.h., the average carrying capacity has been doubled to 6·21 tons, as has the seating capacity to forty-one. It is shown in the report that in 1947–48 the combined staffs of B.O.A.C. and the former B.S.A.A.C. averaged 24,101 persons, and the total revenue worked out at only £607 a head. By March, 1951, the staff of the Corporation had been reduced by 33·3 per cent and the revenue earned per head by March, 1952, had risen to £2047. During this period the operating costs in pence per capacity ton-mile had been reduced from 56·6 to 38·8. At the end of the financial year in review the fleet of the Corporation comprised twenty-two "Argonauts," ten "Stratocruisers," ten "Constellations," twenty "Hermes," and ten "Yorks" on freight service.

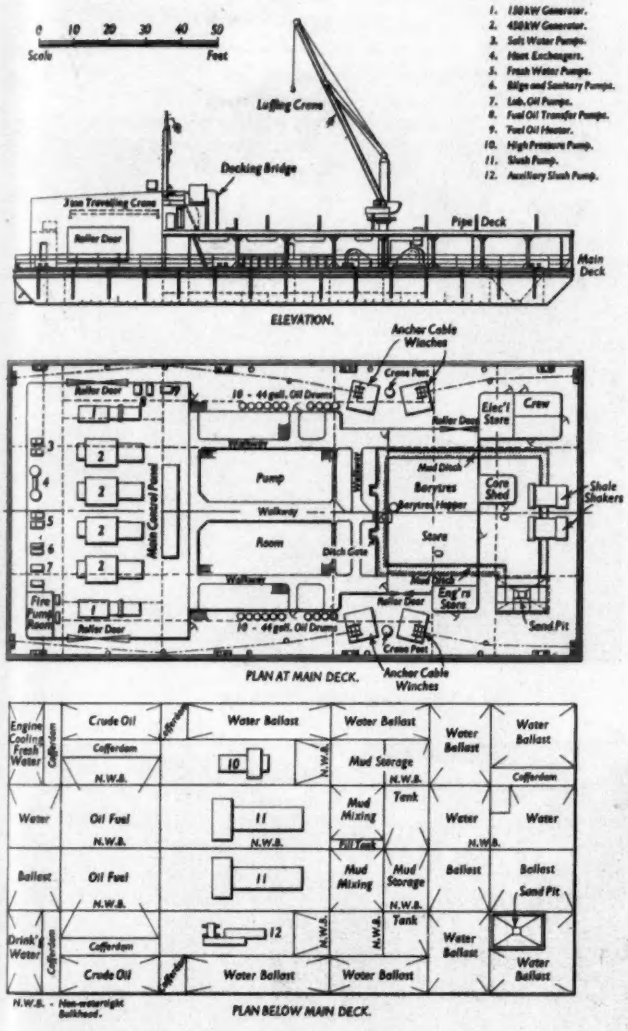
The report then describes in some detail the routes the Corporation operates and the services it provides, and mentions the effect of some of the adverse political developments overseas. Referring to the North Atlantic route in particular, the report states that "Stratocruisers" operated up to eighteen services a week and doubled the previous year's revenue.

Amongst other sections of the report is one dealing with new aircraft and proposed services. It mentions that all orders now outstanding are for British aircraft—the de Havilland "Comet" and the Bristol "Britannia." It discusses the preparations made for the introduction of the "Comet" jet services. The Corporation intends to provide two routes, one from London across Canada to link up at Tokyo, using the existing return route, and the second from London across the United States to meet the British Commonwealth Pacific Airline service to New Zealand and Australia and back to London along the present "Kangaroo" route. In conclusion, the report notes that the safety record of the Corporation has been maintained and 2000 million passenger miles have been operated during the last four years without fatality or serious injury to passengers.

Diesel-Electric Drilling Barge "G.P.2"

Drilling operations in the deeper waters of Lake Maracaibo have called for additional equipment, and to meet requirements the Shell Petroleum Company, Ltd., has under construction a self-contained diesel-electric power barge. This craft, which is non-propelled and has a displacement of 2545 tons, houses all the necessary power plant. It will work in conjunction with a permanent piled steel structure erected at the site of each well.

TO meet the requirements of the drilling operations to be carried out in the deeper waters of Lake Maracaibo, the Shell Petroleum Company, Ltd., decided to have built a self-contained diesel-electric power barge. This craft, although not an entirely new departure in the sphere of marine or inland water drilling technique, is the first of its pattern to be designed, built and equipped in this country. Designated "G.P.2," the diesel-electric floating power station barge was launched from the yard of Ferguson Brothers (Port Glasgow), Ltd., on September 15th. It is expected to complete the vessel by October, and then, being non-propelled, it will be towed to Lake Maracaibo.



General Arrangement of Barge

Built in accordance with Lloyd's Rules and Requirements, Class A (Drilling Barge for Service on Lake Maracaibo or other Enclosed Waters), the barge has the following main particulars :—

Length moulded	156ft
Breadth moulded	80ft
Depth moulded to main deck at sides	10ft.
Designed draught	7ft 6in
Moulded height of pipe deck above main deck at centre line	10ft
Displacement	2545 tons

The vessel, the general arrangement of which can be seen in our line drawing, is of all-welded construction, except the forward ramp end, and is built in rectangular box form, the hull being subdivided by a number of longitudinal and transverse bulkheads to form compartments for water ballast, oil fuel, fresh water, mud mixing, mud storage, crude oil, mud mixing pump room and a sand pit.

On the main deck aft is the main power-house, which is an erection some 70ft wide by 37ft 6in in length, and 20ft high, and fitted with roller doors, 17ft wide by 9ft high, to port and starboard. To facilitate maintenance and overhauls of the machinery a 3-ton overhead travelling crane has been provided. Also accommodated on the main deck are a barytes store, a core shed, stores for the electricians and the engineers, crew's mess and washplace. For mooring purposes the barge is equipped with four electric anchor winches, mounted, two to port and two to starboard, on the main deck. These winches, supplied by the Woodfield Hoist and Associated Industries, Ltd., are fitted with dual control permitting direct operation at the winch and from a control platform on the pipe deck, and are used to handle the 7000 lb Danforth anchors in conjunction with 3¼in mooring cables.

The pipe deck extends practically over the full width of the barge and over most of its length. Special provision has been made on this deck for the stowing and handling of drill pipe, casing and tubing, and on the starboard side there is the engineers' accommodation, while to port is the drilling engineers' combined office, mess and radio room. For the loading and stowing of drill pipe and gear, barytes and other stores, two electric luffing cranes, having a lifting capacity of 3 tons and a maximum working radius of 25ft and a minimum radius of 14ft, have been installed, one on each side of the vessel.

The craft, which houses the main diesel-electric power plant, together with other major and ancillary equipment and materials required for oil well drilling operations, will be used in conjunction with a permanent piled steel structure erected at each well. As designed the barge embodies facilities for making it a self-sustaining power unit for carrying out drilling operations, and has an endurance of thirty days. To meet this requirement, stowage has been provided for the following consumable stores :—

	Tons
Well casing and drill piping	290
Fluid drilling mud	550
Sacked dry drilling mud	90
Diesel fuel oil	150
Lubricating oil	2
Fresh water	25
Sanitary water	3
Miscellaneous well drilling equipment	150
Crude oil	75

Generating Plant

The main power plant consists of four 450kW d.c. generators, supplied by the Metropolitan-Vickers Electrical Export Company, Ltd., driven at 650 r.p.m. by pressure-charged, four-stroke diesel engines built by Mirrlees, Bickerton and Day, Ltd. Each engine has twelve cylinders in "V" form and has a normal twelve-hour rating of 910 b.h.p. and a continuous rating of 698 b.h.p. after allowances have been made for the temperature and humidity conditions obtaining. Two auxiliary generating sets are also sited in the power-house each consisting of a Mirrlees seven-cylinder, normally aspirated, vertical diesel engine, having a continuous rating of 281 b.h.p. at 600 r.p.m. under site conditions, direct coupled to a 150kW a.c. generator and a 20kW d.c. generator in tandem.

Compressed air at 300 lb per square inch is employed for starting the engines, and this is supplied by two air compressors, one diesel driven and the other driven by an electric motor. The engine-driven compressor set, which is suitable for intermittent use for charging air receivers, consists of a Hamworthy, two-stage two-crank, single-acting, vertical water-cooled air compressor, having a free air delivery of 106 cubic feet per minute for short periods when operating against a pressure of 300 lb per square inch. It is driven at 1000 r.p.m. by an A.E.C. marine oil engine, having six cylinders of 120mm bore by 142mm stroke, with a normal output of 100 b.h.p. at 1500 r.p.m. A 25 h.p., 440V, three-phase, 60 c/s squirrel-cage motor drives the second Hamworthy compressor, which is intended for continuous operation and is similar to that already mentioned, but is driven at 575 r.p.m. to give a free air delivery of 60 cubic feet per minute. Two interconnected air receivers, each of 100 cubic feet capacity, are used for storing the air.

There is a closed fresh water cooling system for the diesel engines, and this includes two Serck heat exchangers, one being standby, each of which is of sufficient capacity to deal with the cooling water when all the diesel engines are running simultaneously. The lake water used for cooling purposes is highly corrosive, and to counteract this the heat exchangers are of Monel metal construction with gunmetal water boxes. Duplicate electrically driven Hamworthy self-priming pumps are fitted for circulating the fresh and lake cooling water, and all four are capable of delivering 45,000 gallons per hour against a 35ft head when driven at 1765 r.p.m. by a 15 h.p. motor.

The main 450kW d.c. variable-voltage generators give full-load output at 450V and are of two-field design, a shunt field separately excited from the pony-mounted "Amplidyne" exciter, and a differential series field, a combination which gives the drooping characteristic required to provide the flexibility of controls to the connected d.c. motor and automatic protection against overloading the engine. Each "Amplidyne" exciter has a control field, a current limit field, an equalising field and an anti-hunt field, and they are also used in a circuit to "kill" residual voltage and to stop the motors when the master switch is in the "off" position.

Alternating current at 440V is supplied by the auxiliary generating sets to the various auxiliary motors and the tandem-mounted d.c. generator supplies current at 250V for excitation of the main d.c. motors. Provision is made for synchronising the sets to run in parallel for simultaneous operation should additional power be required. Transformers step down the a.c. supply to 110V for barge and derrick lighting.

Forward of the power-house and below the main deck is the pump room in which are installed two 800 h.p. d.c. motors, having a speed variation from 720 to 72 r.p.m., each independently connected through a quadruple chain drive to two main mud pumps which handle the mud flush requirements of the rig

when drilling. These 8½in by 16in horizontal duplex main mud circulating pumps, provided by the National Supply Corporation (U.S.A.) have fluid ends with a working pressure of 3500 lb per square inch and a normal input rating of 825 h.p. at 65 r.p.m., while the suction and delivery manifolds are arranged for compound or parallel operation of the pumps. To port is a multi-cylinder pump for cementing operations driven by a 300 h.p. motor with a speed range of 750 to 75 r.p.m. This pump, manufactured by the Gardner-Denver Company (U.S.A.), is designed for working pressures up to 10,000 lb per square inch, and is fitted with three 4¼in diameter and three 3½in diameter plungers, each bank being arranged for compound, parallel or independent working. To starboard is an auxiliary 7½in by 12in horizontal duplex mud pump, provided by the British Oilfield Equipment Company, Ltd., belt driven by a 150 h.p. motor having a speed range of 900 to 90 r.p.m. In association with the mud pump is a mud ditch system on the main deck, complete with dual shale shaker screens, settling pits and chemical tank.

Another 150 h.p. motor powers the coring reel unit which is mounted on the top deck. All the electrical motors have been supplied by the Metropolitan-Vickers Electrical Export Company, Ltd.

With the exception of the 300 h.p. motor, which is force ventilated by an individual motor-driven blower, the ventilation of the main d.c. motors is effected by blower equipment manufactured by Keith Blackman, Ltd. The set, for which a duplicate standby unit has been provided, has a capacity of 18,000 cubic feet of air per minute and meets the ventilation requirements of the barge in addition to ventilating the motors.

A draw works motor of 800 h.p., similar to the main mud pump motors, is mounted on the drilling platform, together with a rotary table motor rated at 300 h.p. and similar to the high-pressure cement pump motor. Both motors are force ventilated by individual electrically driven blowers.

Working Arrangements

When carrying out drilling operations the barge can be moored by means of the four 7000 lb anchors at a distance ranging from 25ft to 120ft from the permanent drilling platform. This is mainly a prefabricated rectangular box-shaped structure, having a group of three 20in diameter steel caissons at each corner, which is transported to the desired site and lowered to the lake bed. The assembly forms a jig for the 13in diameter steel tubular piles which are inserted into the caissons, concentricity being assured by fin guides fitted to the piles, and driven into the lake bed. Concrete is poured around the piles to form a reinforced structure adequate to serve the production life of the well.

On top of this structure a steel platform is erected to carry the 136ft high drilling derrick with a 30ft base, together with draw works, rotary table and electric motors. The power for these motors is supplied by flexible cables, and control lines provide the driller with remote control of certain equipment on the barge, such as the mud pumps. A telephone system operates between the platform and the barge, and communication with headquarters on shore is maintained by radio. In conjunction with the drilling platform the barge is capable of drilling to a depth of 15,000ft at points 15 miles or more from the shore.

Works Managers' Conference.—The Institution of Works Managers is to hold a conference in Birmingham on October 16th, 17th and 18th, at which the theme of the discussions will be "Management's Objectives." The conference headquarters will be at the Grand Hotel, Birmingham. The speakers at the conference will include the Minister of Labour, Sir Walter Monckton, whose subject is to be "A Guide to Management"; Mr. A. B. Waring, managing director of Joseph Lucas, Ltd., who will speak on "The Road for Management," and Sir Raymond Priestley, Professor P. Sargant Florence and Professor T. U. Matthew, all of Birmingham University, who will deal with "Technical Training and Education for the Future." The concluding item in the conference programme is a banquet and dance, which will take place at the Grand Hotel on October 18th. Full details of the conference can be obtained from the Institution of Works Managers, 39, Temple Row, Birmingham, 2.

Modernisation of Diesel Engine Works

THE economic conditions obtaining in both the home and export markets call for carefully planned production in order to effect economies and so offset the rising cost of labour and materials. Schemes to attain this end vary with the range of engines built and whether the production is required on a mass or batch basis. At present Henry Meadows, Ltd., Fallings Park, Wolverhampton, is engaged in such a reorganisation and at the invitation of the company we were able to pay a brief visit to inspect the progress made in resiting the machinery to conform with the new production flow layout. Broadly speaking, the scheme involves the concentration of all production into the Cannock Road factory and the transfer of machine tools from the Park Lane Works, which at present, are being used primarily in the role of a feeder to the Cannock Road Works.

The firm was founded by the late Henry Meadows when the manufacture of car gearboxes began in 1920. Within the space of two years the company was producing petrol engines, one of the early four-cylinder models being widely used in several well-known cars. The 4½-litre, six-cylinder engines proved successful as motor car power units and were adopted for a wide range of industrial uses. Later, these engines entered the marine market and soon attracted attention in the high-speed craft field, being standardised by British Power Boat Co., Ltd. The engines were also employed for powering tracked vehicles. In the years preceding the war a 200 h.p., twelve-cylinder, horizontally opposed petrol engine was developed, and upon this design was based the 300 h.p. engine which was used to power the "Covenanter" tank.

During the war the Park Lane Works proved too small and a new factory, the Cannock Road factory, was erected on an adjoining site, to give greatly increased floor space, and was equipped with the latest machine tools. Before the war the company had carried out some experimental work on diesel engines, and this earlier work made it possible for it to enter the difficult post-war market with four and six-cylinder direct-injection diesel engines having a bore and stroke of 130mm. Tests on the new development showed that the concept of the square engine was sound in that it gave a fuel consumption as good

Gear-Cutting Machines

Main Assembly Track

as that of the long-stroke engine, and its low-piston speed resulted in a reduction of wear.

Production trends in the motor-car industry had resulted in the disappearance of the demand for engines and other components by the small car companies, and Meadows engines found a market as power units for commercial vehicles, heavy equipment, industrial applications and oilfield power packs. The shortage of electric power led to the development of self-contained diesel-electric generating sets, which are widely used, particularly in Australia, where the sets often meet the electrical requirements of whole factories. The company's engines continue to find employment in the marine field, and the latest vessel to be fitted with Meadows engines is the experimental fishery research trawler building for the Torry Fishery Research Station. Diesel-electric propulsion has been selected and six engines, four for propulsion and two for auxiliary purposes, are being supplied, these being Mark 6 D.M.S. 970 engines, named "Nelson." This model, which is turbo-charged to develop 225 b.h.p. at 1550 r.p.m., has six cylinders, having a bore and stroke of 5·9in.

The engines are manufactured on a batch basis since the policy of the company has been to produce engines to meet special requirements ; but, under the new policy of reorganisation, to meet the present-day economic conditions, the production of special engines will be limited. As planned, the layout of the works is intended to allow for manufacture on a line basis, while permitting the construction of a number of different engines, and the photographs, reproduced opposite, give a general idea of plant.

At present, the range of engines in production include several petrol engines. For marine purposes there is the "Kittiwake," a four-cylinder, four-stroke, overhead valve engine, developing 28 h.p. at 3000 r.p.m., and the "Kingfisher," of 35 h.p., while for industrial and automotive purposes there is the Mark 4 EL/AV., a four-cylinder engine having a capacity of 3·7 litres and rated to develop 45 h.p. Among the diesel engines manufactured for automotive and industrial purposes is the 4 D.C.-330, of 5·43 litres capacity, which is a four-cylinder, four-stroke, direct-injection, water-cooled engine having a bore and stroke of 120mm and rated to develop 80 h.p. at 2200 r.p.m. It was described in THE ENGINEER of September 15, 1950. Other engines in this group are four-cylinder and six-cylinder models producing 66 b.h.p. and 100 b.h.p., respectively, at 1600 r.p.m., and used to power the company's 35kW and 60kW alternator sets. These engines, suitably modified, are available for marine propulsion, under the names of "Grenville" and "Frobisher," and have a continuous rating of 65 b.h.p. and 100 b.h.p., respectively, at 1650 r.p.m. There is also the six-cylinder Mark 970 engine, which develops 150 b.h.p. when naturally aspirated, and 220 b.h.p. when turbo-charged at 1500 r.p.m. The marine version of this engine, the "Nelson," has a continuous rating of 140 b.h.p. at 1550 r.p.m., and 225 b.h.p. when supercharged.

In the course of the change-over and rearrangement of the machine tools, the drawing-office has been moved to the gallery of the main building, together with other control departments, while the tool-room, spares and service department, despatch department and standards room are located in the perimeter building. When the scheme has been completed and the works are operating to the revised production schedules, it is confidently expected that production will be increased, and the present labour force, of about 1000, raised to a total of 1500. The new layout and the concentration of production in one factory means that a smaller floor space will be used and less transport required, so that both fixed and direct expenses will be greatly reduced. It was stated that, consequent upon the reduction in overhead charges, the engines will be marketed at a substantially lower price.

KENT REFINERY.—During the construction of the jetties for the oil terminal of the Anglo-Iranian Oil Company's Kent refinery stone and iron cannon balls from the Dutch campaign of 1667 have been found in the bed of the Medway.

The Brass Battery Process

AT a meeting of the Newcomen Society for the Study of the History of Engineering and Technology, which was held in London on Wednesday, September 17th, a paper entitled "History and Particulars of the Brass Battery Process" was presented by Mr. B. de Soyres, M.I.Mech.E. In the course of it, Mr. de Soyres said that the process was initiated in the Bristol district early in the eighteenth century and was operated by the Harford and Bristol Brass Company. This company acquired most of the local water power mills on the Avon, the Chew and the Bristol Frome and at the height of its career is said to have owned twenty-two mills, a small establishment on the River Frome in Bristol, called Baptist Mills, at first serving as its headquarters. Subsequently, Keynsham mill—the largest of the group—became the company's headquarters, though it was not a battery mill. A nearby establishment called Chew mill was engaged in the battery process.

Mr. de Soyres went on to explain that the battery process, by which brass pans were produced, consisted in revolving, by hand, flat discs of brass sheet under the blows of a power hammer called a battery hammer, in such a way as to dish up the flat plate into a brass pan with steeply sloping sides and a flat sloping rim. The men operating the process sat in shallow openings—about knee deep—in the floor ; they wore leather knee pads faced with sheet brass, plugged their ears with pieces of rag, and manipulated the pans under the hammer by hand. The rapid succession of blows on the resounding pans, especially when two adjoining hammers were both at work, made a prodigious noise, and, according to Mr. de Soyres, there is a local tradition that Handel drew his inspiration for the "Hallelujah Chorus" from a visit to the Saltford Battery Mill ! To establish the process the company employed men, brought from Flanders, who were already skilled in the trade.

The author stated that of the twenty-two mills reported to have been owned by the company, probably twelve or fourteen were entirely devoted to battery work. The mill at Saltford, on the River Avon below Bath, was being worked as a brass battery mill until about 1908. It was the last to operate as such in this country, although one or two battery mills in other parts of England were using battery hammers in the manufacture of scythe blades, &c., up to a much later date.

That portion of the Saltford mill devoted to battery had two undershot water wheels, running at about 18 or 19 r.p.m. The battery plant had its water wheel mounted on one large cast iron shaft, perhaps about 27ft long by 24in or so in diameter, and weighing some 15 or 20 tons. This shaft carried three large cast iron cog wheels with inserted wooden cogs and drove three hammers. The earlier wheels had twenty cogs, were about 48in diameter, and struck 360 blows per minute, or six blows per second. The water wheel was about 18ft diameter, which seems to have been the most frequent size for both the Keynsham and Saltford mills. The hammer shafts or "helves" were of beech wood, about 8ft long, pivoted very near to their lower, or driven ends, which the descending cog struck forcibly down on to a sunken anvil or rebound plate. The sharp rebound of the short end accelerated the natural fall of the longer end. This carried the long-nosed hammer head which thus struck a very powerful blow on to an anvil sunk in a large iron-bound piece of tree trunk buried in the floor. Scores of different weights and sections of hammers were employed. The anvils were just over 5in square and 6in high, of iron with good steel faces, and their upper surfaces varied from a mere narrow ridge, often sloping, to an almost flat surface 5in square. The hammers were stopped by the workmen rapidly thrusting in a sprag called a "stulch" under the rear part of the ascending hammer shaft. This "stulch" was a tough piece of hardwood about 30in long by 2¼in diameter, with stout iron ferrules on the ends. The wooden hammer helve passed through a heavy oval iron ring fitted with two trunnions. This ring was called the "husk," and the two shallow cup brasses in which the trunnions turned were "husk brasses." The formation of a deep pan from a flat piece of brass sheet was only reached by many hammerings, each followed by a complete annealing at a red heat. To expedite the process of annealing, the pans were nested by placing smaller pans within larger ones, a batch of about 5 cwt being considered to be a fair load for the furnace. Suitable sizes of pan were bound together pack fashion and so remained for several consecutive operations without being parted, two pans within a third, the edges of the outer pan being turned in to hold them all together ; this outer pan was termed a "ferrier."

Much of the battery plant at Saltford was of very heavy wooden construction. An attempt to modernise the plant on one battery wheel failed completely. The new plant was on the Birmingham model with a very heavy wrought iron shaft, and short vertical frames of cast iron in place of the tall wooden posts, but the whole outfit was insufficiently heavy and the shaft which carried the cog wheels, instead of revolving steadily, vibrated badly and rose right out of its bearings. A very large bearing was then turned centrally on this big shaft whilst it revolved *in situ*, and large bearings and caps were fitted to hold it down.

A Unit Dust Collector

A NEW design of unit dust collector now being made by Dallow Lambert and Co., Ltd., of Spalding Street, Leicester, is stated to be suitable for almost every kind of dust produced in industrial processes. These units are arranged for assembly to suit particular applications from five different standard fans and motors, two different standard filter assemblies and four different standard dust-storage containers. By combinations of standard parts units can be readily built for applications requiring a large air volume, but producing little dust, to those requiring a small volume of air having a heavy dust content. One of the new units can

Unit Dust Collector

be seen working in conjunction with a grinding machine as illustrated above.

The fan, with its totally enclosed motor, is situated in the upper chamber of the collector cabinet, and the filter is arranged immediately below. The flame-proofed fabric filter is cleaned by a semi-automatic shaker gear controlled by a handle at the side of the unit. Two large doors give free access to all parts of the fan and filter chambers.

Dust from the filter drops into a quick-release bin at the bottom of the unit, and this bin is sealed to the hopper inlet chamber by a quick-release lever arrangement. Suction inlet openings are arranged on all four sides of the unit just below the filter chamber and, according to the application, one or more of the inlets can be connected by ducting to the point of dust emission. These standard units are available with fan capacities ranging from 175 to 2000 cubic feet per minute and driven by motors from ½ to 2½ h.p.

Motive Power for Railways

By C. M. COCK, M.I.Mech.E., M.I.E.E., M.I.Loco.E.

In his presidential address to the Institution of Locomotive Engineers on Wednesday, September 24th, Mr. C. M. Cock dealt at some length with alternatives to steam locomotives for traction purposes. The address, which is abstracted below, included the economics and working of railcars, electrification systems, diesel locomotives, gas turbine locomotives, the problems of fuel supply and the possibilities of nuclear energy.

MY remarks mainly will concern some alternatives to the reciprocating steam locomotive. I cannot subscribe, however, to any suggestion that the steam locomotive should be dismissed in a peremptory fashion. In spite of any predilection towards other forms of traction forced upon me by circumstance, the steam locomotive still appeals to me. For most people of any age the steam locomotive is a fascinating thing and it is sturdy, reliable, cheap. It is the very backbone of rail transportation in this country, and in the majority of other countries in the world, and it is likely to remain supreme in this respect for some time yet.

To-day, the steam locomotive suffers chronically, as it has done for a century and a quarter, from an unfortunate inability to digest the full substance of its calorific food. Aggravated by a large appetite this incurable indigestion leads to other ancillary ills in processes of repairing, fuelling, watering and general servicing, and, realising all this, railwaymen are seeking for other forms of traction having better qualities in thermal efficiency and availability always, however, with a wary eye on the cost.

There seems little prospect of further major development of the reciprocating steam locomotive, which, quoting the Federation of British Industries when giving evidence to the Ridley Committee on the national fuel policy is, in a fuel efficiency sense, one of the least efficient machines to survive in a modern age.

It would be foolish to say one form of traction is better than another merely because it may be more modern or fashionable. Every form of rail traction is a means to an end, and that is to move trains. A very careful assessment is necessary to determine real values of traction in respect of cost, and efficient and reliable movement of traffic. The assessment must also take into account the suitability of the tractor to the particular territory, keeping in mind the topography and the natural resources.

Practical alternatives to the steam locomotive, not necessarily in order of precedence, are : (1) self-propelled railcars, (2) electrification, (3) the diesel-electric locomotive, (4) the gas turbine locomotive.

There is a good deal of misconception regarding railcars, probably arising from a belief that they are mere buses on a railway, possibly hauling a trailer. The fact is that important developments have been made in diesel-powered units in recent years and they have become firmly established in many countries. They range from single cars to different combinations of power units and trailers which may make up powerful train sets, running at high speed on main trunk lines.

Multiple-unit sets, in a sense, are something between electrification and the ordinary steam-hauled passenger train, and there would seem to be great scope on British Railways for this kind of development.

Although, on equation, the electric locomotive is easily the most powerful and efficient of all types of locomotive, and the cheapest to maintain, the cost and characteristics of the locomotive itself cannot be accepted in any fair comparison with other forms of traction. Nevertheless, electrification under favourable conditions can be the cheapest and most efficient of all forms of traction.

There are three basic electrical systems applied to railway traction as follows :—Direct current ; alternating current, single-phase ; alternating current, three-phase.

The three-phase system which has been applied mainly in Italy can be dismissed from consideration at once. The constant-speed traction motors make operation somewhat inflexible and the arrangement of the conductors over the track introduces considerable complexities, particularly at junctions ; therefore, it is unlikely that three-phase traction will be adopted anywhere for new electrification.

The d.c. system is in use successfully in many countries throughout the world at voltages ranging between approximately 600 and 3300. It is not yet practicable to use direct current at voltages much in excess of 3300. Some 22,000 miles of single track have been electrified on the d.c. system with overhead contact line or conductor rail.

On the a.c. single-phase system some 19,000 single track miles have been electrified mainly in Sweden, Germany, Switzerland and the United States of America, and the installations in commercial operation on this system use electrical energy at low frequency, 16⅔ or 25 c/s. Some experimental equipment at the industrial frequency of 50 cycles is also in use.

It has been proved beyond any doubt whatever that both the d.c. systems and the a.c. single-phase low frequency systems can work with maximum reliability and efficiency. There is also promise in the 50 cycles, a.c., single-phase system.

The issue can be decided quite clearly and logically on examination of facts. The justification for the electrification of any railway, and the system to be adopted, is primarily, but not entirely, economic ; the value of electrification as a capital investment is determined by comparing the working expenses after electrification with those of steam operation under similar conditions, and a reduction in working expenses must be found more than sufficient to meet the additional fixed charges due to electrification. This applies principally to such main line electrification where no increase in traffic due to electrification may be expected.

With suburban electrification, however, the track capacity can always be increased. More trains can be run to provide a more regular, faster and more frequent service than that provided by the displaced steam service.

The Weir Committee (1931) estimated that complete electrification of British Railways would require some 5700 million units of electrical energy per annum and a recent check confirms that this figure still holds good. It represents approximately 12 per cent of the total units sold in the year 1950–1951 and this load would result in some improvement in the load factor on the national grid, due to the diversity between the railway and other loads, particularly if more and faster goods trains were run at night.

For the same horsepower at the train, the current required by the locomotive on a 15,000V, single-phase system (for example) is not much more than one-tenth of the current on a 1500V d.c. system. It follows that the overhead conductor for the higher voltage may be of smaller cross section and the number of substations may be materially reduced. In general, therefore, the higher the operating voltage, the lower are the first costs and the resultant capital charges of the fixed installation.

On the other hand, with an increase in operating voltage there is an increase in the cost of the electric locomotives and electrical equipment of coaches ; so that to determine the economic effect of the variables on any proposed system of electrification for any particular line or territory the actual case must be worked out, and estimates of costs must be calculated for various voltages.

It is apparent that high traffic density tends to favour the adoption of low voltage, and, conversely, low traffic density favours a high voltage ; but the balance can only be assessed on the basis of estimates of cost taking into account the actual conditions applying to a particular scheme.

So far as the annual charges in respect of locomotive coal versus electric power, and steam locomotive operation and maintenance versus that of electric are concerned, savings can be obtained after electrification, irrespective of whether this be a main line project, a suburban one or a combination of both.

Interest is now aroused by the possibility of using single-phase electrical energy for traction at the industrial frequency of 50 c/s. The attraction of this system is that it reduces to a minimum the cost of the fixed installation. Power may be taken direct from the National Grid instead of from generating stations specially designed for low frequency supplies ; with a high contact line voltage the traction substations can be spaced at long distances and reduced to their simplest form, i.e. merely containing stepdown transformers. This development may open a field for electrification which could not be justified on the standard systems in use to-day.

While the 50 cycles system may be attractive in so far as the cost of the fixed installation is concerned, there are on the other hand disadvantages with the electrical equipment of the vehicles, and the effect of unbalance on the main three-phase power network of the single-phase traction supply. The a.c. single-phase commutator motor still compares unfavourably with its d.c. counterpart in characteristics, in weight and in first costs, and in maintenance costs, although it must be admitted that the designers are narrowing this gap.

For various reasons, including economic considerations, the British Transport Commission has accepted the 1500V d.c. system as standard for British Railways but the 50 cycles system has not been ruled out for electrification of secondary lines with light traffic.

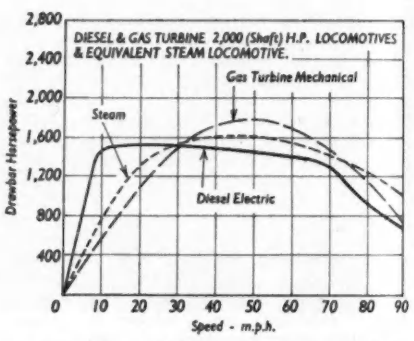


Fig. 1—Drawbar Horsepower Speed Curve

The diesel is the most efficient heat engine available at the present time for practical application in a locomotive, but the overall cost of translating efficiency into useful work at the wheel rim must be weighed when determining whether this type of locomotive is indeed a more economical tool for transportation than the steam locomotive.

The net thermal efficiency of the diesel-electric locomotive at the rail is, at about 26 per cent, very much higher than the steam locomotive. Performance at the drawbar is very different from the steam locomotive, as shown in Fig. 1. The direct drive of the steam engine results in the horsepower rising with the speed, whereas the diesel engine with electrical transmission can operate to develop its full rated power output over a wider and more useful range of road speed. The advantage is obvious with freight services, yard working and heavily graded lines, but where long-sustained high-speed runs are involved it is possible that the diesel-electric locomotive may lose some advantage.

There has been a phenomenal growth of diesel traction on the main line railways of North America and the same form of traction is regarded with increasing favour in many other countries. The total deliveries of new diesel locomotives to American railways in 1951 was 3558 units—an all-time record.

The picture is quite different here in Britain,

where only six main line diesel locomotives are in operation. These are for trial purposes; five have electrical transmission, one has mechanical transmission. For yard shunting purposes diesel locomotives of some 350 h.p. and under have proved under certain conditions of operation to be more economical than steam locomotives and their use on British Railways and in large manufacturing works is rapidly extending.

In the U.S.A. the cost of fuel for equivalent work done by diesel electric locomotives is on average little more than 50 per cent of that for coal-fired steam locomotives in passenger and freight services.

For shunting the corresponding figure is about 30 per cent on a shunting hour basis. It is significant that British results are very nearly the same at about 29 per cent, and it should be noted that the substantial number of diesel-electric shunting locomotives now in service in Britain establishes this figure on a reliable basis.

A very important, and to some of us in this country a possibly surprising point emerging from Table I, is that the differential in cost per B.Th.U. as between oil and coal is rather more

TABLE I—*Fuel Costs*

Delivered to railway fuelling depot	Calorific value, B.Th.U. per lb	Cost per ton	Cost per 1000 B.Th.U.
Diesel fuel oil :			
U.S.A.	19,000	£11·5	0·065d.
U.K.	19,000	£16·0	0·0905d.
Coal :			
U.S.A.	13,000	£2·1	0·0173d.
U.K.	10,500-14,500	£4·0	0·0355d. aver.
Ratios :			
U.S.A.	—	Oil/coal = 5·47/1	Oil/coal 3·74/1
U.K.	—	Oil/coal = 4/1	Oil/coal 2·57/1

in the U.S.A. than it is in Britain. It is not illogical, on this basis, to assume that savings in operating costs could be secured in Britain of no less a proportion as those obtained in the U.S.A.

Maintenance and repair costs for main line diesel locomotives in the U.S.A. are stated to average only one-third to one-half of those for steam locomotives and there appears no reason why the same trend should not be obtained in Britain and also in other countries outside the U.S.A.

The average cost per horsepower for diesel locomotives in Britain is rather more than double that for steam locomotives, whereas in the

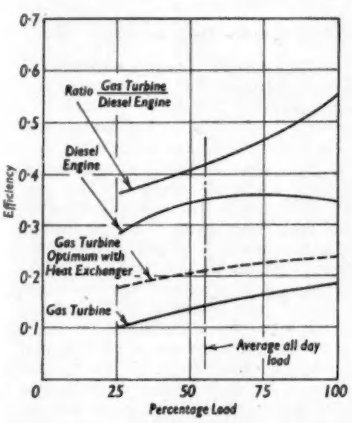


Fig. 2—Diesel Engine and Gas Turbine Comparative Efficiencies

U.S.A. the contrast is more favourable to diesel locomotives.

Considerably more time is required for servicing, repairing and inspecting steam locomotives than is required for diesels, and as a result the availability and utilisation of the diesel is considerably higher than for steam locomotives. It has been found in the U.S.A. that diesel locomotive units on freight service average twice the annual mileage and on passenger service from two to three times the mileage for steam locomotives. For shunting service nine steam locomotives are needed to do the same work as five diesels.

In the U.S.A. considerable speeding-up of both freight and passenger services has been possible with diesel locomotives. Average train miles per train hour on freight and passenger services have increased 20 to 30 per cent above the figure for steam. In parallel with these speed increases there have been big increases in the gross freight ton-miles hauled per locomotive mile and in the passenger coach miles for the diesels, as compared with steam.

In the U.S.A., in spite of the relatively high first cost of the diesel locomotive, overall operating and repair costs, inclusive of depreciation of interest charges, in terms of gross ton-miles hauled and coaching miles run, are only about 60 per cent to 65 per cent of that for steam.

Of all the factors contributing to the economy of diesel traction in the U.S.A., it would seem that chiefly those concerning capital costs and utilisation might be unfavourable perhaps in Britain. British conditions of railway operation are not similar to those in the U.S.A., particularly with regard to routes lending themselves to long runs and a high degree of locomotive utilisation. There are, however, to be considered the many other favourable factors which reasonably may be expected to follow the pattern that has produced such spectacular results in the U.S.A.

Taking into account the relative costs and calorific values of diesel fuel and coal in Britain, a theoretical evaluation indicates that for equivalent work done over the same route with the same trailing load the cost of fuel for the diesel-electric locomotive is less than the steam locomotive by about only 10 per cent, and this is supported by actual field tests. When the respective capital charges are added to the account the higher first cost of the diesel locomotive swings the balance in favour of the steam locomotive to the order of 25 per cent. But such conclusions when drawn from particular and individual comparisons are unrealistic. The real general and total costs must take into account the many contributing auxiliary factors when a large number of diesel locomotives displaces a considerably larger number of steam locomotives for equivalent work, i.e. the factual position of a completely "dieselised" area or division of a railway.

There is no question of the technical success of diesel locomotives for main line work in this country, and there seems little doubt that, by the American criterion and the relative British differentials in cost, there is opportunity for commercial success.

Many of the steam turbine locomotives have performed well in comparison with contemporary reciprocating locomotives, but the fact is that eventually they have either been consigned to the scrap heap or converted to conventional type.

Gas Turbine Locomotives

Meantime attention has been turned to the gas turbine, which shows greater promise for locomotive applications, the ultimate hope being that it will enable smaller, cheaper and more powerful locomotives to be built within the limits of existing axle weights and load gauges.

To railwaymen the advantages of the gas turbine locomotive arise from simplicity and consequent low maintenance costs, high ratio of power to total length and weight of locomotive, and high availability factor. As with the diesel locomotive, however, the overall cost, including maintenance, fuel and capital charges, must be measured under similar conditions of operation against other forms of traction, of which the reciprocating steam locomotive is the convenient yardstick.

The thermal efficiency of gas turbines is limited by various factors, but were it not for practical commercial considerations such as size, weight and cost, there would be no insuperable obstacle to-day to building a gas turbine with a thermal efficiency of 45 per cent or even higher. The best figure yet achieved for the more restricted space in a locomotive is 19 per cent at the turbine shaft. The full power efficiency of the locomotive is reduced with electrical transmission to 15·5 per cent at the rail.

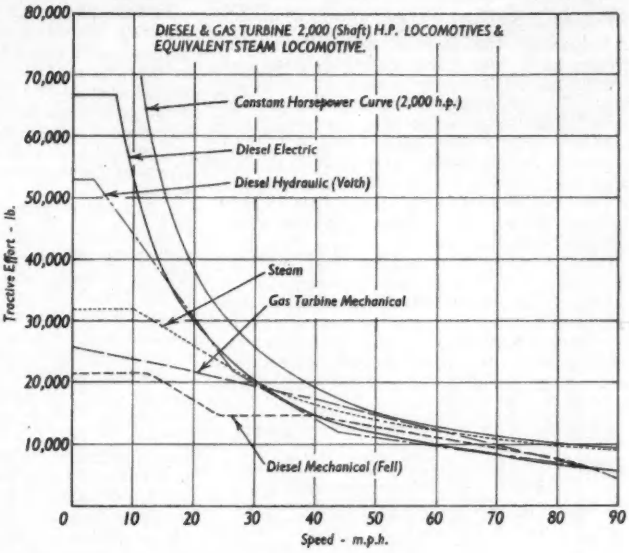


Fig. 3—Tractive Effort Speed Curves

As gas turbine locomotives so far have been built and maintained in isolation, and in different countries, it is not possible accurately to assess the true capital costs and the overall costs of maintenance. In contrast with a diesel locomotive, the capital costs may possibly be lower when produced in quantity and the maintenance costs may be lower due to simplicity.

Fuel costs, however, are higher than the diesel and this is not only because of lower efficiency at the full load rating. Since a locomotive under service conditions runs for only part of the time on full power, the all-day thermal efficiency at the rail will be considerably lower than the full load rating. If the varying duties be assessed as equivalent to running continuously at an average of 50–60 per cent of full power, then the average thermal efficiency of a gas turbine locomotive at the turbine shaft is not more than 15 per cent, compared under the same conditions with 35 per cent from the diesel engine, as shown on Fig. 2. These curves indicate also that the diesel engine has much more suitable characteristics over the range of varying load encountered in railway operation. Variations in ambient temperature have an important influence on the performance of gas turbines, which may be favourable or unfavourable, depending on the climatic conditions in the territory of operation.

It would seem at the present stage of development that the gas turbine locomotive holds some promise of economy in capital and maintenance charges as compared with the diesel locomotive, but until the all-day thermal efficiency at the rail can be improved considerably the margin of overall economy is unlikely to give the gas turbine locomotive superiority over the diesel locomotive.

In fact, dynamometer car trials on British Railways indicate that the thermal efficiency of gas turbine locomotives so far tested is little better than that of steam locomotives when hauling similar loads over similar routes. In fairness, this result does not do full justice to the gas turbine because the full power was not utilised, and no final conclusion can be drawn as to overall economy until the total costs are

taken into account, including the many contributing factors, when a large number of these locomotives displaces a considerably larger number of steam locomotives for equivalent work.

It is fundamental that any rail tractor should be able to exert a high tractive effort at standstill, falling away as the speed increases. A steam reciprocating engine or a turbine automatically develops much more torque at standstill than at normal speed, but as a diesel engine of itself is not capable of this: some kind of torque converter is necessary.

Power Transmission to Road Wheels

Power can be transmitted from a diesel engine, and also a gas turbine prime mover to the road wheels of a locomotive either by electrical, mechanical or hydraulic means, or combinations of these means. The majority of high power diesel locomotives have electrical transmission ; only a few have been built with hydraulic or mechanical transmission in the range above about 500 h.p. With the exception of the French experiment, all gas turbine locomotives already in service operation have electrical transmission.

From Fig. 3, it is evident that electrical transmission is the nearest approach to the ideal speed/tractive effort characteristic obtainable from a locomotive, and there is no question that electric cables, motors and single-reduction gears provide the most flexible connections between the prime mover and the road wheels,

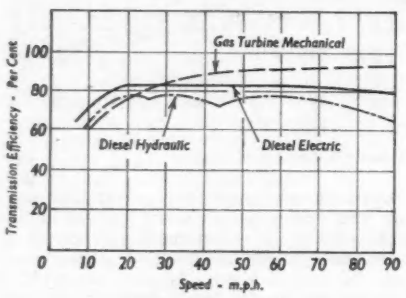


Fig. 4—Comparative Transmission Efficiencies

thus eliminating from the design of the locomotive dominating restrictions caused by mechanical driving shafts and gearboxes, even at the cost of weight and space, which in some applications may be important. Electrical transmission permits individual axles to be motored as desired and offers the greatest freedom in the co-ordination of maximum tractive effort with permissible axle loads and total weight of locomotive.

For low power locomotives various mechanical or hydraulic or combinations of these means of transmission have become established on the grounds of higher efficiencies and lower first costs. Fig. 4 shows the differences in efficiencies of the various transmissions, which in all-day operation cannot have a very great influence on the costs. It is mainly on the score of first costs and weight that alternatives to electric transmission are chosen.

No equally satisfactory alternative to electric transmission has so far become established or to any large extent proven for diesel or gas turbine locomotives of high power.

Another means of converting the power of the diesel engine to tractive effort at the road wheels is by variable rates of speed and of pressure charging whereby the cylinder pressure is high at low engine speed and gradually falls to a lower value at top engine speed. The engine torque varies accordingly and the power output tends to be constant over the full range of engine speed. With this principle, however, the effects on the engine are severe at low speeds, due to the very high maximum cylinder pressures. The loading conditions created require generous bearing areas, particularly on the big ends.

There is no fundamental reason why the inherent torque characteristics of the gas turbine should not be utilised by gearing it to the road wheels of a locomotive. Such a scheme probably could be devised cheaper in first cost than electrical transmission and be more efficient so far as internal losses are concerned. But in cases where maximum proportions of the weight of large locomotives are required for adhesion, difficulties and complications arise in coupling together large numbers of axles which must work equally well in both forward and reverse directions. Comparing locomotives of equal power at the shaft of the prime mover, the mechanical drive with the gas turbine still falls somewhat short of the ideal speed tractive effort characteristics inherent in the electrical drive as shown on Fig. 3.

In due course nuclear energy may also be used probably converted to electric power for traction purposes, and winds and tides may be harnessed to produce electric power to a limited extent. In the absence of tangible commercial development, only the hope can be expressed that some day nuclear energy may be more abundant, more convenient and cheaper than other forms of energy at present known to man.

Electrification and Diesel Traction

In Britain, excepting the diesel applications previously referred to, coal provides the power for all railway traction services. Some 19,500 steam locomotives with an optimum thermal efficiency of 8 per cent consume approximately 14 million tons of our best coal per annum, so that at least 92 per cent of the energy of this coal is discharged wastefully from the chimney or lost by other diverse means ; more is wasted in " stand-by " and preparation losses. With electric traction much less coal would be consumed in central power stations which, by 1960 may have an average thermal efficiency of 26 per cent; and taking into account the transmission and conversion losses, probably not more than 81 per cent of the total energy of coal would be lost in translation to useful work at the train, but there are no " stand-by " losses—an important factor which is often forgotten, and difficult to assess precisely.

It is a reasonable estimate that general electrification in Britain would reduce coal consumption to two-fifths, at the most, of that now required by steam locomotive haulage.

With regard to motive power for railways, it is found in the U.S.A. that 1 ton of diesel fuel will do the work of at least 9½ tons of coal. On this basis, and in the event of complete " dieselisation " of British Railways, the annual consumption of diesel fuel would be less than 1·47 million tons.

The reciprocating steam locomotive has survived for so long, not by any claim to technical superiority, but because it is cheap and sturdy and simple. For these reasons, and for some time ahead, it will remain on many railways in accordance with the concept of George Stephenson. But the proven success of alternative forms of traction should give cause for serious thought to railway administrations all over the world as to whether indeed the ancient tradition of steam continues to be valid.

The examples of the success of electric and diesel electric traction in the world to-day are substantial and real. The potential of the gas turbine locomotive cannot be forecast until it has been proved.

Here in Britain, the long experience and economic results of electrification provide sufficient proof and justification for further large-scale extensions which could confer immense benefits on the nation, economic and otherwise, a new type of transport would give the railways a new lease of life and bring them back to their proper prime place in the transport system as a whole, save precious coal, diminish pollution by smoke, and bring some improvement to the load factor on the national electricity supply grid.

There is also room for extensions of diesel traction. The economic success of this has already been established for shunting in just the same way as a start was made in the U.S.A., and the experiments made with main line locomotives have proved their technical superiority over steam locomotives. These experiments, however, have not been sufficient to demonstrate convincingly the true operational and economic advantages of this form of traction on a really large scale.

American Engineering News

(By our American Correspondent)

A Gaseous Diffusion Plant for the Atomic Energy Commission

The U.S. Atomic Energy Commission has announced that it will build a new gaseous diffusion plant for the production of uranium 235 at a site in Pike County, Ohio. About 6500 acres of land will be acquired, the exact boundaries of the site being determined after the completion of detailed engineering surveys. The funds for the project were made available by a law signed by the President on July 15th. The potential availability of power at reasonable cost in the quantities needed for the operation of the plant and the availability of water were important factors in selecting the site. The gaseous diffusion process, designed to separate fissionable uranium 235 from non-fissionable uranium 238, is one in which uranium hexafluoride in gaseous form is pumped through thousands of extremely fine barriers which have millions of holes per square inch. Since U-235 atoms are slightly lighter and therefore travel slightly faster, they strike the screens and pass through the holes with greater frequency than do U-238 atoms. This process gradually separates the U-235 atoms.

It has been stated that the operation of the plant will involve no appreciable radiation hazards. In the six years that a similar plant has operated at Oak Ridge, Tennessee, not a single employee has suffered a radiation injury. The preliminary design calls for a plant estimated to cost about 1,200,000,000 dollars. Its initial operation will require electric power up to 400,000kW, which is to be supplied from existing facilities, and new power stations will be built to supply the maximum of 1,800,000kW, which will be required once the entire plant is in operation. Although portions of the works will be placed in operation as soon as completed, the construction of the plant as a whole is scheduled to take about four years. For a short peak period the number of workers will be about 30,000, but, except possibly for one year, the average number employed on construction is not expected to exceed 17,000. The acquisition of the land will be handled for the Commission by the Corps of Engineers. The principal construction contractor for the new plant is the Peter Kiewit Sons' Company of Omaha, Nebraska.

The Palisades Dam in Idaho

A contract to supply four 39,500 h.p. hydraulic turbines for the 114MW Palisades power station on the south fork of the Snake River near Irwin, Idaho, has been awarded by the U.S. Bureau of Reclamation to the S. Morgan Smith Company of York, Pennsylvania, on a tender of 1,421,700 dollars. The station is being constructed to provide approximately 700,000,000kWh of hydro-electric power annually for the development of phosphate for defence needs, as well as power for the atomic energy installations at Arco, Idaho and extensive irrigation in the Upper Snake Valley. Under the contract, the first turbine parts will be delivered by July, 1954. The urgent need for additional hydro-electric power supply in the eastern Idaho region and for stabilisation of irrigation water supplies was recognised in the last session of the Congress, when a 2,000,000-dollar item for the Palisades project was included in the final supplemental appropriation bill. The Defence Electric Power Administration endorsed the construction of the plant as important to the American defence effort. At present, the construction of the dam and power station is proceeding under a contract awarded by the Bureau on April 18th to a low joint venture bid of 29,180,346 dollars by the J. A. Jones Construction Company of Seattle, Washington, and the Charles H. Tompkins Company of Washington, D.C. The Palisades dam scheme, which is scheduled for completion in 1950 days, includes the construction of a 260ft high, 2000ft long earth-fill dam ; it is believed to be the largest ever built by the Bureau of Reclamation, and it will provide a storage reservoir having 1,400,000 acre-feet capacity.

A Chloromycetin Plant

THERE has recently been completed at the Hounslow factory of Parke-Davis Co. Ltd., a new large-scale synthesising unit for the production of chloramphenicol under the trade name of "Chloromycetin." This is an antibiotic and because of the complex nature of the chemical processes involved in its manufacture a wide range of specialised plant was required, which has been supplied mainly by the three members of the Balfour group of companies.

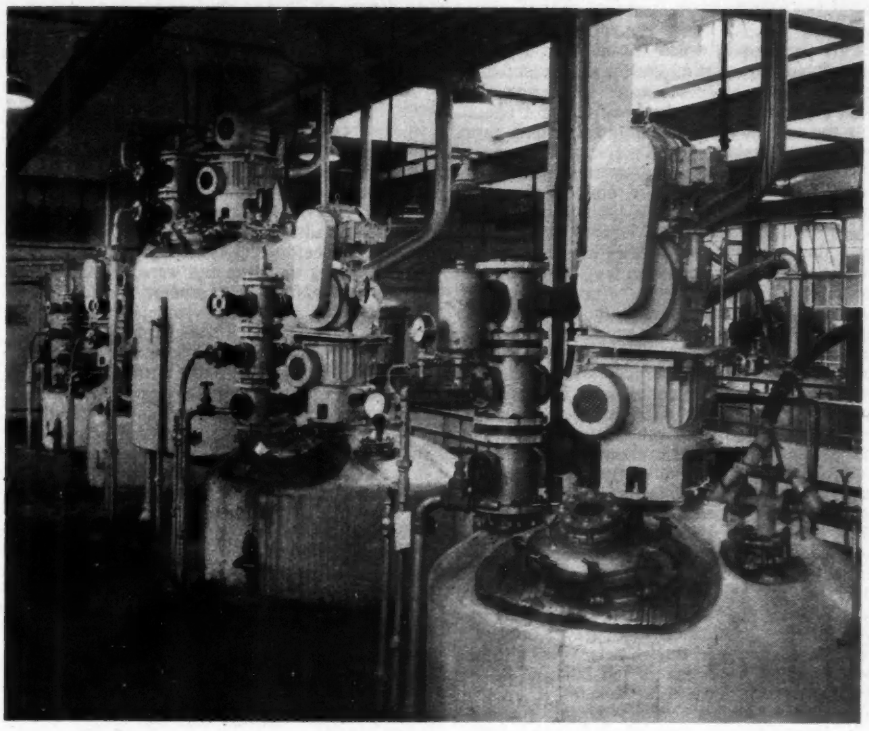
The whole process involves some eleven reactions, which are divided into four main stages, which use Pfaudler glass-lined jacketed reaction vessels, Pfaudler-Balfour jacketed stainless steel units, Pfaudler glass-lined refluxing units and Scott vacuum shelf dryers and a solvent recovery unit. Some of the plant used can be seen in our illustrations.

The main process block, which measures 175ft by 50ft, consists of two stories and a basement, with a wing, in which process development and pilot plant work are carried out. The block is divided by a blue brick wall and the first floor of each section has a central well measuring 40ft by 20ft, above which are lantern roofs to give adequate headroom. With the exception of areas of chequer plating all the floors are of acid-resisting "Prodorite" blue tiling surmounting two coats of acid-resisting asphalt, which in turn are laid over a concrete screeding deposited upon precast concrete flooring.

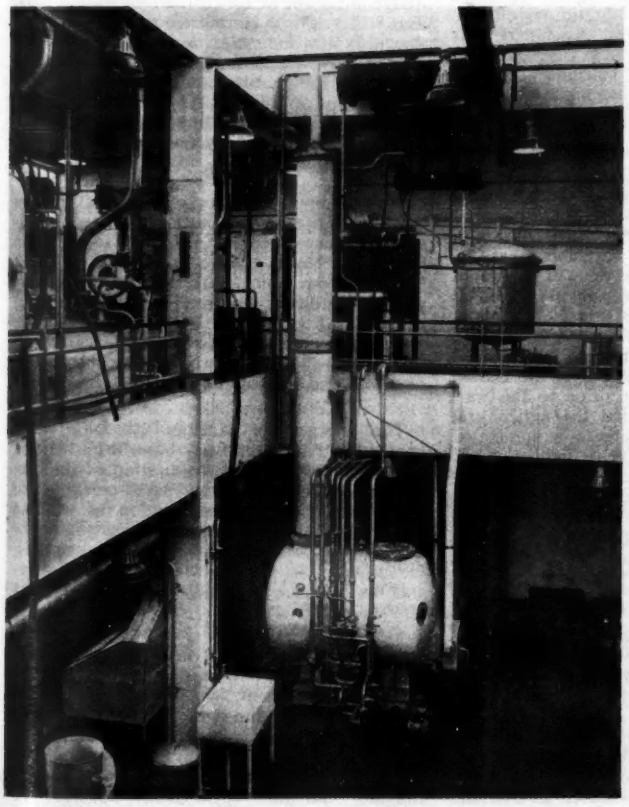
The basement has been excavated around the site of an existing well, which serves to augment the cooling water supply. In the basement is housed the ice-making, crushing and storage plant, a calorifier for the hot water system and a condensate collection unit for handling process condensate prior to its return to the boiler house.

Due to the presence of solvents and other highly inflammable materials, fire precautions have received a good deal of attention. The central wall is of fireproof design and has double fire-proof doors, so that a fire can be restricted to one half of the building..

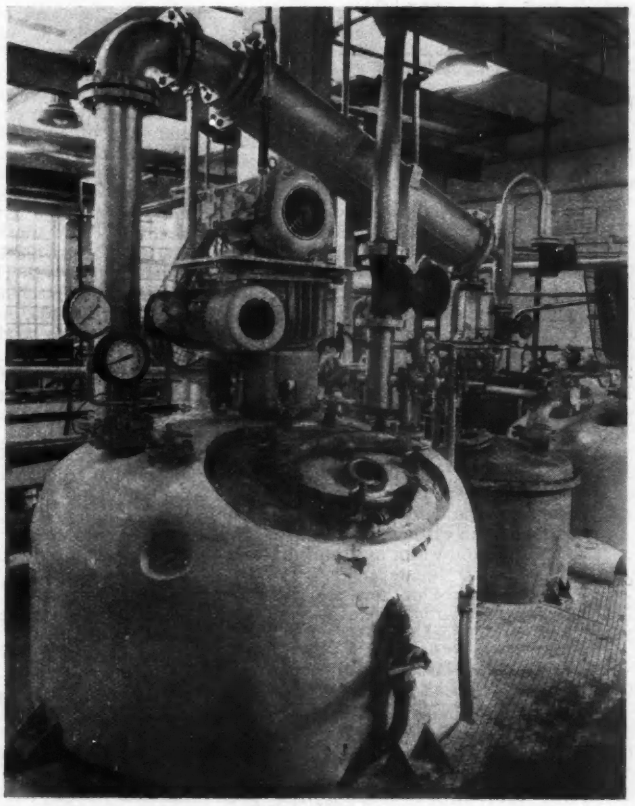
The first three steps of the first stage are carried out in glass-lined reaction vessels. In these the great variation in solids content, viscosity and other characteristics associated with these reactions have set up agitation problems, the solution of which has called for the installation of hydraulically operated variable speed gears with a wide range of speeds. The arrangement of the reactors and auxiliary equipment gives ready accessibility to charge-holes, cocks, valves, agitators and controls and stainless steel centrifuges of the three-point suspen-



Condensation Process Vessels



Still and Fractionating Column for Solvent Recovery



Reflux Still Unit

sion pattern are used for filtration operations. Stainless steel or glass-lined reaction and refluxing units are employed in the second and third stages, including units for the purification and resolution of optical isomers and the acid hydrolysis stages.

Each reactor has an individual control panel, upon which are mounted temperature indicators and recorders, vacuum pressure gauges, steam and cooling water control valves and agitator starters, while steam supplies at pressures of 5 lb per square inch or 30 lb per square inch are available at the panels and may be connected to each vessel. Each control station has a centre panel upon which are mounted a process timing clock, pre-set meters for the measurement of solvents and process water to all vessels in that bay, and remote control switches for operating the solvent pumps at the solvent tank farm.

In the final stages in the production of "Chloromycetin" there are several drying operations for which hot air equipment has been provided, together with a battery of vacuum shelf driers. Automatic safety devices are provided in order to ensure that over-heating does not occur and to prevent any contamination of the valuable materials concerned. As vehicles in the various reactions, large quantities of solvents are used and the recovery of these is in itself a complex process and special plant has been installed for this purpose and also for the recovery of methyl alcohol used in the initial stages.

In keeping with the general fire precautions, all service supplies to the building are in duplicate. Steam, water, solvents, compressed air, and general service vacuum lines are all led independently to each half of the building so that either may be isolated at short notice. Installed in the building is a comprehensive extraction system and high velocity extraction ducts have been led to all vessels, while fume hoods are fitted at the tables for filling the vacuum oven and shelf drier trays, centrifuge balance tanks and drier outlets. As with the other services each half of the building has its own extraction fan and air washing equipment. The piping systems for the various processes have involved the employment of many materials, including stainless steel, glass and rubber-lined steel, aluminium, polythene and tinned copper, and wherever possible this pipe-work has been placed directly under the first floor so as to provide ready access from below.

Continental Engineering News

(By Our Continental Correspondent)

The Volga-Don Canal, U.S.S.R.

The Soviet Authorities recently opened the Volga-Don Canal, which links the Baltic Sea and the White Sea in the north with the Caspian Sea, the Black Sea and the Azov Sea in the sonth. The canal is about 70 miles long and stretches from Stalingrad on the Volga to Kalach on the Don. Construction was started before the war, but the work was interrupted during the hostilities and resumed in 1948. The scheme includes various hydro-electric works, of which the Tsimlyansk power station, with an installed capacity of 160MW, is the most important. In addition to its use for the generation of power, the dam associated with the power station will control both navigation and irrigation. The Tsimlyansk power station is constructed on an earthen dam 8¼ miles long, built across the Don, which has formed a reservoir covering 2300 square miles. The construction of the Volga-Don canal required about 215 million cubic yards of earthwork (about as much as for the Suez Canal).

The Birsfleden Hydro-Electric Scheme on the Swiss-German Border

The programme for the development of electrical power from the Rhine between Lake Constance and Basle contains provision for the construction of a power station at Birsfleden, between the Augst-Wyhlen plant (built in 1912) and the Kembs plant (erected in 1932). The general layout of the scheme includes a dam, power house, and a lock with approaches for shipping. The dam will consist of five sluiceways, each about 90ft wide, this dimension being the same as the spacing of the piers of the Basle Bridge over the River Rhine. The lock will be about 600ft long and 40ft wide, with approach channels of 1460ft by 197ft to 262ft (downstream) and 1360ft by 146ft (upstream). The power house will be equipped with four Kaplan turbines of 28,000 h.p. and will generate about 440 million kWh per year. Works on the scheme was started in 1950, and is expected to be completed in 1954. About 325,000 cubic yards of concrete will be placed on the contract.

The North-South Railway Junction at Brussels, Belgium

On October 4th, the King of the Belgians will officially open to traffic the junction line destined to link the north and south stations of Brussels, which are about 2 miles apart. Works for the construction of the Junction Railway across the Belgian capital city started before the 1914–18 war, were interrupted during that war and were resumed some twenty years later. The scheme provides for a six-track line partly on viaducts (1200 yards) but mainly in tunnel (2200 yards). There are three intermediate stations between the North and South terminals: the Central Station and stations at Chapelle and Congress. The tunnel, constructed by the "cut-and-cover" method, was completed in 1949. The contractors used the following method for its construction: first a layer of soil across the width of the tunnel was excavated and steel sheet piling was driven on each side of the tunnel. Ground water was lowered and kept under control by well points. Foundations were then sunk for steel columns designed to support the steel shoring. This shoring formed the skeleton for the reinforced concrete of the completed tunnel. The normal tunnel cross-section consists of three bays, each containing one pair of tracks, separated by two rows of stanchions.

Agricultural Machinery Survey

THE thirty-sixth report from the Commonwealth Economic Committee—which has been published this week by H.M. Stationery office—surveys trade in agricultural machinery. It includes a general review of the world production and utilisation of agricultural machinery, detailed information on the agricultural machinery trade in Commonwealth countries and in other areas, and some observations on recent developments. The statistics contained in the report show that, in 1950, the world production of tractors was estimated at 989,048, compared with 231,137 in 1938. Of the 1950 output, the Commonwealth's share was 169,988—compared with 11,168 in 1938—the United Kingdom's production being 150,488. The total value of the output of agricultural machinery generally in the United Kingdom, Canada, Australia and New Zealand was estimated to be about £150,000,000 in 1950, and this, the report says, represented between 30 and 35 per cent of the output of the U.S.A. compared with 15 per cent prior to the war. The report acknowledges that the agricultural machinery "picture" continues to be dominated by the U.S.A., where the immense industrial and agricultural productive capacity give a commanding lead in the volume of production and utilisation. But, it is stated, other countries are taking a growing share in international trade, and in that respect Commonwealth countries are particularly notable. In recent years there has been a great acceleration both in the growth of numbers of machines on farms and in the development of new appliances. Many of the traditional barriers to further mechanisation are being broken down, a process which seems likely to continue. Comparing like with like, the report says, agriculture in Commonwealth countries is, on the whole, more highly mechanised than elsewhere. The report adds that, notwithstanding the great progress in agricultural machinery which has been achieved all over the world, there is technically scope for much more.

French Engineering News

(By Our French Correspondent)

The hundredth anniversary of the Anciens Etablissements Sautter-Harle has just been celebrated. This firm was founded by Louis Sautter in 1852. Starting as manufacturing opticians and concentrating on huge lenses for lighthouses, the company later developed an electrical side, and Sautter built industrial dynamos and applied them to a variety of uses. These applications included the first electrically propelled submarine. The company also carried out work with alternating current and constructed several powerful turbo-alternator sets. Its work has included the manufacture of submarine mines, munitions, transport, and turbo-alternators for steam power stations.

* * *

Details of the second French four-year development plan have now been published. It envisages spending about £2,000 million between 1953 and 1956, of which some £600 million will go into agriculture. The plan includes development of the French nitrogen industry, which has been started already with the construction of the Carling works in the Moselle. Irrigation will play a large part in the plan; certain regions of the Bas-Languedoc and other areas in the south are to be irrigated. The rural transport system will be overhauled, rural housing will enjoy a priority, and France will develop the construction of agricultural machinery to a point far beyond the present position. Emphasis will be placed on small machines, such as the small electric motors used in agriculture for milking machines, to give one example. Certain zones of France will be turned into experimental stations for machines to be used in agriculture and activities connected with agriculture. It is hoped that production of these agricultural implements and machines will be increased by about 18 per cent and that prices will be brought down by about 15 per cent. One thousand four hundred million pounds of the expenditure envisaged will be devoted to industry. A large section will go to non-engineering industries, such as the food industries, shoes and textiles. Building and civil engineering will, nevertheless, receive an important part.

* * *

Work on what is thought will be the largest bridge in Europe at Tancarville will start in 1953. The bridge will be completed, it is hoped, some time in 1956. Estimates have been received from French and foreign firms, and the cost of the bridge will amount to several million pounds. The new bridge will cross the Seine at Tancarville and will have a single span of 1400m. It will be 12m wide and the roadway of the bridge will be 47m above the river.

* * *

Water supply in Morocco in general, and in the Casablanca area in particular, is to be considerably developed. An intake some 70km from Casablanca, at Oued Oum-er-Rbfa, is to be built, from which water will be brought by gravity to a distribution reservoir at Casablanca, where it will be treated. It is estimated that the project will cost about £4 million to carry out. The work will include two 25,000 cubic metres reservoirs and a distribution system.

* * *

The Forges et Acieries du Nord Est announces that in the Briey basin it has carried out a comprehensive modernisation of the iron mines. This work included special crushing and grading equipment, modernisation of winding plant, mechanisation throughout the mines, the development of mechanical loaders for the ores, the installation of several electric locomotives and the purchase of a number of large trucks of 40.to 60 tons capacity.

* * *

The Forges et Acieries de Nord et Lorraine has installed new crushing plant to serve its furnaces. The result, it is said, is a steep fall in production cost and in the price of iron ingots. In the mines mechanical extraction apparatus and equipment are now being installed and will shortly be ready to come into service. The company has now spent some £300,000 on modernisation.

Industrial and Labour Notes

Engineering and Shipbuilding Wages

As we go to press with these notes the executive council of the Confederation of Shipbuilding and Engineering Unions is holding a special meeting to consider the latest developments in the wages dispute. On Thursday of last week representatives of the Engineering and Allied Employers National Federation discussed with officers of the Ministry of Labour the considerations that had led to the rejection of the claim made by the unions for a wage increase. They pointed out that the need for maintaining the maximum effort in the export drive and in production for essential home industries made it imperative to avoid any additional burden on the engineering industry.

At the meeting with the Ministry of Labour officials it was explained that the employers had reviewed the question of an increase in wages with the utmost care. They felt, however, that to agree to an increased wages cost at a time when the economic situation was restricting purchasing power and when competition from certain other countries was growing was against the interests of all sections of the industry and against the possibilities of maintaining full employment. Nevertheless, the employers' representatives informed the Ministry that, in an endeavour to assist in resolving the present position, they would be prepared to submit the whole matter to arbitration, and would undertake to be bound—with the unions—by any award of any tribunal that might be appointed.

On Tuesday of this week there were conversations between Ministry of Labour officials and representatives of the Shipbuilding Employers Federation. The shipbuilding employers, it was then stated, considered that the latest wage claim was without regard to the economic position of the country and the industry—a consideration which entirely justified rejection of the claim. But, like the engineering employers, the Shipbuilding Employers Federation was quite agreeable to the dispute going to arbitration.

Ministry of Labour's Annual Report

The annual report of the Ministry of Labour and National Service was published at the end of last week by H.M. Stationery Office. It reviews the work of the Ministry during 1951, the principal activities being surveyed under the headings of manpower, services of the Ministry, industrial relations, and international labour relations.

Five chapters of the report are devoted to the subject of manpower. In them it is recorded that last autumn the total working population reached a peak of 23,500,000, the highest figure ever recorded in peacetime. The demand for labour, represented by the number of vacancies notified to employment exchanges and youth employment offices as remaining unfilled, rose to 504,000 in July, 1951. In the second half of the year, however, there was a decline and by December the number had fallen to 313,000. The report says that the number of unfilled vacancies in the textile and clothing industries was reduced during last year, but that the number of unfilled vacancies in the metals, engineering and vehicles groups of industries increased. The strength of H.M. Forces rose by 100,000 during the year to a total of 852,000, which figure represented rather more than 3·5 per cent of the working population. The total number of people in civil employment rose last year by 116,000 to a figure of 22,221,000, or nearly 95 per cent of the working population. In a chapter outlining the general manpower situation, the report says that the Ministry continued throughout the year the facilities for the recruitment of foreign workers by employers in important industries. By the Ministry's schemes, approximately 3000 Italians were brought to this country mainly for employment in brickmaking, iron ore mining, iron and steelfounding, the tinplate industry, and British Railways. Altogether about 36,000 permits were issued to employers during the year for the admission of individual foreigners to work here. The report states that unemployment declined substantially during the first six months of last year and by July the figure was 185,000—the lowest since mid-1945. Thereafter, however, the number of unemployed rose rapidly month by month to a total of 303,000, though that figure represented only 1·4 per cent of the estimated total number of employees. The increase in the unemployment figures in the latter half of last year is attributed in the report partly to seasonal causes and partly to the general economic situation.

One item mentioned in the chapter on industrial relations relates to the constructive part taken by the Ministry's conciliation officers in the avoidance and settlement of disputes. Altogether, 330 disputes were settled by agreement in the course of the year.

Britain's Overseas Trade

The Board of Trade accounts for August, which were published at the end of last week, show that exports of United Kingdom goods during the month were valued at £180,800,000. Comparison with the July total of £207,800,000 shows a decrease of 13 per cent, though the Board of Trade points out that such comparison is misleading in view of the fact that there were twenty-seven working days in July and twenty-five in August. If the daily rates of export in the two months are compared, the reduction is 6 per cent. Taking July and August together, exports averaged £194,300,000 a month, a decrease of 7 per cent on the average for the second quarter of this year and 19 per cent on the first quarter.

Between July and August there was a drop in exports of engineering products. The average monthly value of machinery exports so far this year has been £35,803,000, but in August it fell to £31,503,000. Exports of vehicles in August were valued at £31,683,000, a figure nearly £10,000,000 below this year's average. Considering engineering products generally, the Board of Trade says that the value of exports in July and August was 9 per cent below the average for the second quarter of the year. Exports of iron and steel in August were valued at £13,629,000, compared with a monthly average value this year of £15,620,000. On the other hand, coal exports in August, valued at £4,816,000, were above the monthly average and were 80 per cent higher, in value, than last year's monthly average.

The downward trend of imports into this country continued during August, the total value for the month being £263,206,000. The monthly average value of imports this year has been £306,309,000. Re-exports in August were valued at £8,900,000 (compared with £12,900,000 in July), so that the excess of imports over total exports was £73,500,000. The average excess in the first half of this year was £78,400,000.

Deferment of Call-up

The Ministry of Labour has announced an extension of existing arrangements for granting deferment of the calling up of a limited number of ex-apprentices belonging to certain highly skilled occupations and working on "super-priority" rearmament projects. The revised arrangements will include men, belonging to the same highly skilled occupations, who are employed in establishments mainly engaged in the categories of engineering work of particular importance to exports or in merchant shipbuilding.

The Ministry has published a list of "designated categories of engineering products" to which these arrangements apply. It points out that the opportunity of seeking deferment under the scheme is limited to establishments within this defined field which have a good export performance, or have definite prospects of achieving such a performance in the near future, and which train apprentices, some of whom they need to retain in order to maintain or improve their export activity. The occupations to which the arrangements apply include practically all the highly skilled trades in the engineering industry—such as particular classes of draughtsmen, tool makers, instrument makers, and ships' draughtsmen—except for some occupations from which all the ex-apprentices becoming due for call-up are required in the services as tradesmen.

As under the existing arrangements, deferment will be for two years after completion of apprenticeship. It will be granted only to men whose skill is being fully used in connection with designated export work and where the position cannot be met by the provision of a substitute. No man will be made to accept deferment of call-up against his will. The Ministry of Supply and the Admiralty will notify those establishments coming within the scope of the scheme and advise them of the procedure to be followed if and when they wish to apply for deferment of the call-up of individual men. Each application will be fully investigated, and the final decision whether to grant deferment in an individual case will be taken at the headquarters of the Ministry of Labour. Where deferment is granted, the case will be reviewed about every six months in order to verify that the man is still being properly employed and to the full extent of his skill.

Training for Ironfounding

In March last the Council of Ironfoundry Associations held a three-day conference to discuss various aspects of "Training for Ironfounding." There has now been published, in booklet form, a full report of the proceedings at the conference, including the introductory addresses and the ensuing discussions. Broadly, the conference concerned itself with the training of craftsmen, foundry technicians, foremen and junior executives, and both the introductory talks and the discussions following them constituted a valuable examination of methods and systems of training that are now being applied in the ironfounding industry.

The booklet is available from the Council of Ironfoundry Associations, Crusader House, 14, Pall Mall, London, S.W.1, price 3s. 6d.

Markets for Industrial Production

In the course of his chairman's address at the recent annual meeting of the Finance Corporation for Industry, Ltd., Viscount Bruce of Melbourne said that, since 1937, the world's industrial production had increased by at least 80 per cent. But in 1951 the volume of international trade was only about one-third higher than in 1937, and the expansion in capacity and output was continuing, especially under the stimulus of rearmament. It was true, Lord Bruce added, that part of the great increase in industrial production was being consumed internally as a result of greater employment and higher standards, but in spite of that the volume seeking entry into world trade showed a tremendous expansion.

Great Britain, Lord Bruce continued, had already expanded the volume of her exports over the pre-war level by 60 per cent, and must further increase her exports if she was to maintain her financial and economic stability. Practically all the other industrial nations were also seeking a greater outlet in the world's markets. In face of those ever-growing supplies flowing into the export market, Lord Bruce commented, it had to be realised that without a great expansion of world trade there was not room for all. He suggested that world trade could best be expanded by creating new real wealth and creating it in such a way that impediments to the free flow of that trade could be overcome. One of the most effective ways of creating that new wealth, Lord Bruce said, was by the development of the latent resources, particularly of the backward countries, and above all of the countries of the British Empire.

Notes and Memoranda

Rail and Road

BRITISH TRANSPORT COMMISSION.—The Minister of Transport, following consultation with the British Transport Commission, has reappointed for a further term of one year from October 1st the chairmen and members of the various transport executives whose present appointments expire on September 30th. The Road Passenger Executive will cease to exist after September 30th.

COLOUR-LIGHT SIGNALS ON SOUTHERN REGION.—A further stage in the Southern Region scheme to equip the whole of the London to Brighton Line with modern colour-light signalling will be completed next month, when the new system is put into operation between Battersea Park and Selhurst. On Sunday, October 5th, colour-light signals will replace the old semaphore signals between Streatham Common and Selhurst, and on the following Sunday, October 12th, colour-light signalling will be introduced on the route between Battersea Park and Streatham Common. Eleven signal-boxes will be abolished and replaced by three new all-electric boxes situated at Clapham Junction, Balham and Streatham Junction. These three boxes, which between them contain a total of 225 miniature working levers and operate thirty-nine automatic sections, will control the whole of the 125 multiple-aspect, long-range colour-light signals between Battersea Park and Selhurst, a distance of 14¾ miles.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Institution of Locomotive Engineers has announced the following awards for papers read during the 1951–52 session: Frederick Harvey Trevithick award to Lieut.-Colonel L. F. R. Fell for his paper, "The Fell Diesel-Mechanical Locomotive"; Institution of Locomotive Engineers award to Mr. J. F. Harrison for his paper, "The Application of Welding to Locomotive Copper Fireboxes"; Alfred Roslin Bennett award to Mr. D. W. Peacock for his paper, "Railway Wind Tunnel Work"; special award to graduates under twenty-five to Mr. J. F. Thring for his paper, "Structural Design of Lightweight Steel Coaches for the Indian Government Railways." In addition to these awards, the retiring president, Mr. J. S. Tritton, has given a "President's Prize" to Mr. R. A. G. McDermott for his essay on the Institution's visit, in May last, to the Corby works of Stewarts and Lloyds, Ltd. All the awards were presented at a general meeting of the Institution, held in London last Wednesday evening.

Air and Water

RADAR DEMONSTRATION UNIT.—A mobile unit of Decca Radar, Ltd., is to make a tour of Germany, Denmark, Sweden and Norway to give demonstrations before shipowners in a number of ports in the countries named.

LIGHT VESSEL.—Philip and Son, Ltd., Dartmouth, launched Light Vessel No. 13 from its Noss Works on September 17th, this craft being the twenty-first successive Light Vessel built by the company for the Corporation of Trinity House.

SUEZ CANAL.—The statistics issued by the Suez Canal Company indicate that a record volume of shipping passed through the canal during the half-year ended June 30th. The total volume was 43,801,000 tons, representing 6273 transit passages, and exceeded the 1951 returns by 4,684,000 tons. British participation increased by 647,000 tons to 14,254,000 tons, or 32·5 per cent of the total volume.

FIRE PRECAUTIONS IN AIRCRAFT ENGINE TESTING.—Regulations which have been made under the Factories Acts by the Minister of Labour prescribe precautions to be taken to reduce the risk of fire and explosion in all factories in which the testing of aircraft engines or of carburettors or fuel pumps for aircraft is carried on. The regulations, which come into operation on November 1st, replace somewhat similar provisions to those contained in an order made in 1944 under Defence (General) Regulation 60.

AIR TRAINING COLLEGES IN INDIA.—A contract has now been signed between Air Service Training, of Hamble, Southampton, and the Government of Pakistan, to create in Pakistan two new schools of public school pattern which will give education up to an extremely high standard to boys aged between eleven and a half and seventeen and a half who are intending to enter the Royal Pakistan Air Force as apprentices or cadets. This arrangement arises directly out of a long-standing arrangement by which Air Service Training has been accepting in this country for both technical and flying training Pakistan civilians and Air Force officers. It is thus the first time that any attempt has been made to export the whole conception of the British public school, in spirit and organisation. Air Service Training is a member company of the Hawker Siddeley Group.

HIGH-SPEED BOAT "CRUSADER."—In the construction of the high-speed boat "Crusader," which has been built by Vosper, Ltd., for Mr. John Cobb, an essential condition was the provision of maximum strength in association with minimum weight, and this has been achieved by using, as building materials, a combination of birch plywood and certain aluminium alloys. The special problems involved by the employment of the light alloys for the stressed sections of craft have been solved and the material has been adopted for the actual planing surfaces of both hull and sponsons and for the highly stressed sponson arms and the main frames of the hull. Plywood has been used for the construction of the rest of the boat. The aluminium alloys have been supplied by the British Aluminium Company, Ltd., and for the bottom of the sponsons plating ¼in thick to specification NP 5/6, a 4 per cent magnesium aluminium alloy, has been used. For the sponson arms and main frames material to specification HC 15 WP, having a 0·1 per cent proof stress of 20 tons per square inch, has been employed and clad with pure aluminium as a measure of protection against corrosion. Strong material was necessary for the construction of the sponson arms, since they are heavily loaded when the boat is running, particularly in rough water, and so a high-strength alloy used for aircraft was chosen. The loads from the sponson arms are transmitted to the boat through the built-up box girder hull rings, which enclose the engine. Those structural members of the craft which are less highly stressed, such as chine angles, are in N.E.6 alloy, and certain fittings, including cowlings, lower strength aluminium alloys, suitable for marine purposes, have been worked.

Miscellanea

ISLE OF WIGHT OIL WELL.—Oil drilling operations by the D'Arcy Exploration Company are expected to begin near Arreton, Isle of Wight, on October 1st.

ZINC PRICE CHANGE.—The Ministry of Materials has announced that as from September 21st the price of good ordinary brand zinc has been decreased from £126 to £122 per ton delivered consumers' works. Premiums for higher grades remain unchanged.

DIESEL PRODUCTION.—Since the opening of the new Peterborough factory of F. Perkins, Ltd., in November, 1947, 100,000 six-cylinder diesel engines have been built. The occasion was marked by a special ceremony and the 100,000th engine was presented to Canada.

LLANDARCY EXPANSION.—The fifth and last of the new jetties built to serve the Llandarcy refinery of the Anglo-Iranian Oil Company, Ltd., has been completed. All the jetties, at Queen's Dock, Swansea, are of spun concrete to defeat the Teredo mollusc and can accommodate tankers of 28,000 tons deadweight, five of which can be discharged simultaneously. The autofining unit for removing sulphur from oil during refining is processing tractor vaporising oil and has achieved design capacity of 5000 gallons per hour.

MANCHESTER LIBRARY'S PATENTS COLLECTION.—The Manchester Technical Library has issued a booklet describing its collection of patent specifications and other patents literature. This booklet, which has been prepared by Mr. J. E. Wild, the assistant Librarian, explains that the collection of specifications and other patents publications housed in the Manchester Technical Library is one of the largest in this country outside the Patent Office. On March 31st last, the collection included 28,000 volumes, each containing about 200 specifications.

IRON AND STEEL COMPENSATION.—The Ministry of Supply has stated that the total compensation for the 146 agreed securities under the Iron and Steel Act, 1949, has now been finalised at approximately £245,800,000. As announced recently, the Iron and Steel Arbitration Tribunal determined the value of the final security—the Staveley Iron and Chemical Company, Ltd.—at 20s. 6d. per share. The amount of compensation stock to be issued to the former shareholders, the Staveley Coal and Iron Company, Ltd., has now been decided at £8,200,000.

STUDY OF INDUSTRIAL MEDICINE.—Eighteen medical officers and others concerned in the health of industrial workers from thirteen Western European countries are taking part in a course arranged by the British Council on "Industrial Medicine in Great Britain." It began in Manchester on September 19th. The course includes a review of the National Health Service and particularly the statutory and voluntary arrangements made in industry which affect the health of the individual as a member of an industrial community. Lectures and visits to factories have been arranged to show what is being done in the way of accident prevention and health care in different kinds of industry. Two days are being spent this week in West Cumberland and visits will be made to the hæmetite mines, where the working methods have done much to eliminate pneumoconiosis. The last week of the course, beginning September 30, will be held in Birmingham, where the programme will show the work which is being done in industrial rehabilitation. Members of the course will visit the Birmingham Accident Hospital to see the Medical Research Council's industrial injuries and burns research unit.

THE NIMONIC ALLOYS.—Henry Wiggin and Co., Ltd., has now issued a revised edition of its general publication, giving detailed properties of the Nimonic range of high-temperature materials. It includes the "long-time" creep test curves and shows that the creep curve for Nimonic 80A at 700 deg. Cent., with a load of 7 tons per square inch, has now been completed, the specimen fracturing at 34,065 hours, giving a strain of approximately 1·15 per cent. Although Nimonic 80A was primarily designed for use at high temperatures for short times, these data show that this alloy is also suitable for use for long periods at these temperatures. It is noted that these curves were all obtained on material as heat-treated for aircraft service. Investigations are at present in hand to develop the best possible long-time creep properties and the properties shown in the publication should, therefore, be taken as an indication of the minimum properties which can be developed. Also included are short notes on Nimonic 95, the latest published addition to the series of creep-tested wrought alloys, together with general description of Nimonic DS and Nimonic DT, which are modifications of Nimonic D introduced recently. This publication is issued free of charge.

NORTH-EAST COAST INSTITUTION.—The sixty-ninth session of the North-East Coast Institution of Engineers and Shipbuilders will begin on Friday, October 17th, with a meeting in the lecture theatre of the Literary and Philosophical Society, Newcastle upon Tyne, at which Lieut.-Colonel T. Eustace Smith will deliver his presidential address. On October 31st the Parsons Memorial Lecture will be delivered to the Institution by Mr. C. Seippel, of Brown Boveri and Co., Ltd., the title being "From Stodola to Modern Turbine Engineering." This year's Andrew Laing lecture is to be given on December 12th by Mr. Hayne Constant, F.R.S., Director of the National Gas Turbine Establishment. His lecture will deal with "The Application of Research to the Gas Turbine."

DESIGN OF ROLLING MILLS.—In June, 1951, a conference arranged by the plant engineering division of the British Iron and Steel Research Association was held in London, the subject for discussion being "The Design of Rolling Mills." B.I.S.R.A. has now published in book form the four papers presented at the conference and a full report of the discussions on them. The papers are as follows: "42in Slabbing Mill at Shotton," by Mr. J. F. R. Jones; "Blooming and Billet Mills at the Normanby Park Steel Works of John Lysaght's (Scunthorpe Works), Ltd.," by Mr. J. A. Peacock; "Rod and Bar Mill at Guest Keen and Nettlefolds (South Wales), Ltd., Cardiff," by Mr. G. A. Phipps, and "Light Section Mill at the Darlington Works of the Darlington and Simpson Rolling Mill Company, Ltd.," by Mr. W. French. The cost of the book is 10s., and it may be obtained from the British Iron and Steel Research Association, 11, Park Lane, London, W.1.

Personal and Business

MR. R. H. VEYSEY has been appointed public relations officer to Rolls-Royce, Ltd. (motor-car division), 14–15, Conduit Street, London, W.1.

VICKERS, Ltd., Broadway, London, S.W.1, states that Viscount Knollys, G.C.M.G., has been appointed an additional member of the board of directors.

THE ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS, 54, Station Road, New Barnet, Herts, announces that its telephone number is now Barnet 9141.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., and the Edison Swan Electric Company, Ltd., have opened new district offices at 10–12, Hospital Street, Birmingham.

THE ENGINEER SURVEYORS' ASSOCIATION states that Mr. F. S. Bowen, of Manchester, has been elected president for 1952–53, and that Mr. J. G. F. Carrol, of London, has been elected vice-president.

C. H. JOHNSON (MACHINERY), Ltd., Adswood Road, Stockport, has been appointed sole selling agent in Great Britain for power cranes manufactured by Brun and Cie, A.G., Nebikon, Switzerland.

THE BOARD OF TRADE states that Mr. G. S. Owen will be retiring on October 1st from his post as under-secretary in the commercial relations and exports department. He will be succeeded by Mr. G. H. Andrew.

THE BRITISH ALUMINIUM COMPANY, Ltd., has opened a branch office at 20, Brunswick Place, Southampton (telephone, Southampton 76780; telegrams, Britalumin, Southampton). Mr. W. H. Marston is the area representative.

ROCKWELL MACHINE TOOL COMPANY, Ltd., Welsh Harp, London, N.W.2, announces that, subject to the settling of certain formalities, the Coventry Gauge and Tool Company, Ltd., is to manufacture for it the Sundstrand 24in "Lapmaster" machine.

DOMINION, SCOTT, BARRON, Ltd., is the title of a company formed in Canada by Dominion Wheel and Foundries, Ltd. (Canada), the Balfour group of companies, Leven, Fife, and W. S. Barron and Son, Ltd., Gloucester. Its address is 171, Eastern Avenue, Toronto, 2.

FOUNDRY SERVICES, Ltd., Nechells, Birmingham, 7, announces that Mr. John Cartwright has left for Stockholm to take up his duties as resident technical representative in the Scandinavian countries. Foundry Services (Canada), Ltd., is now operating from its new works at 201–207, Alice Street, Guelph, Ontario.

CANADIAN PACIFIC STEAMSHIPS, Ltd., has appointed Mr. J. R. Y. Johnston as naval architect with headquarters at Liverpool. Mr. Johnston, who was a senior ship surveyor of the Ministry of Transport at Glasgow, will supervise the existing ships of the company's Atlantic fleet and any new tonnage which may be constructed.

MR. G. T. H. SPURLING, A.M.I.Mech.E., has resigned his position as commercial manager, turbine division, of the Brush Electrical Engineering Company, Ltd., Loughborough, to become chief assistant to Mr. I. V. Robinson, M.I.C.E., M.I.Mech.E., head of the turbine and allied plant sections of BEAMA. Mr. B. L. Gover has succeeded Mr. Spurling as commercial manager, turbine division of the Brush Electrical Engineering Company, Ltd.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester, announces the following appointments: Mr. R. H. S. Turner, assistant works manager, main works; Mr. A. Paterson, assistant works manager, Mosley Road works, including Leonard Works; Mr. J. S. Wright, superintendent, plant department; Mr. J. A. Brooks, superintendent, Leonard Works; Mr. R. M. A. Smith, assistant sales manager, instrument and meter department.

British Patent Specifications

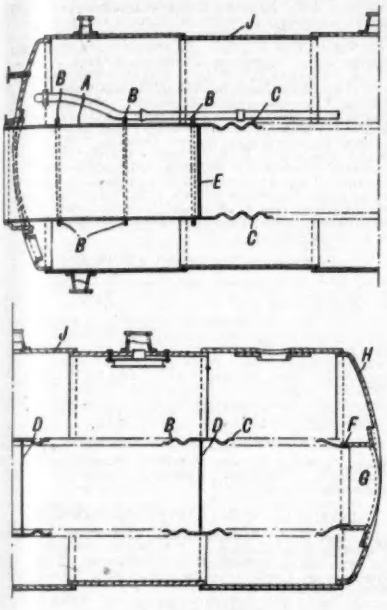
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 8d. each.

STEAM GENERATORS

677,827.—March 29, 1950.—FLUE TUBES FOR STEAM BOILERS, John Thompson (Wolverhampton), Ltd., Ettingshall, Wolverhampton, Staffordshire, and Howard Hartland, of the company's address.

Referring to the drawing, the furnace portion *A* of the flue tube is a tube, and is provided with encircling rings or bands *B* of flat cross-section welded edgewise at points along its length. The remainder of the flue tube beyond the furnace portion comprises a number of corrugated tubular sections *C* welded directly end-to-end at *D*, the forward end of this corrugated portion of the flue tube being welded directly to the rear end of the plain furnace tube at *E*, and the joint being strengthened by the adjacent encircling ring *B*. The joints *D* between adjacent corrugated sections *B* of the flue tube may each be strengthened by an encircling ring or band welded



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on either adjacent tube section *B* in close proximity to the joint. The rear end of the corrugated portion is welded or riveted at *F* directly to the flue outlet *G* in the rear end plate *H* of the boiler shell *J*, and this joint may also be strengthened by a welded-on ring located adjacent the joint *F* on the rear end of the corrugated portion. By the invention only the furnace portion of the flue tube is in the form of a plain tube. Riveted joints can be avoided throughout the length of the furnace tube within the boiler shell. The number, size, spacing and cross-sectional shape of the reinforcing rings will be such as to ensure adequate strength to resist the external pressure on the furnace portion of the flue tube, and they need be of only small cross-sectional area so that they do not interfere with the heat transmission through the wall of the tube.—*August* 20, 1952.

PUMPS

677,674. June 16, 1950.—ROTARY PUMPS OR ENGINES, Edgard Jacques Bourquin, a Swiss, of 19, Cite Jardin, Beauchamp, Seine-et-Oise, France, formerly of 25, rue Henri Barbusse, Genevilliers, Seine, France.

As illustrated in the drawing, the pump or motor consists of an oval casing *A* with a supporting pedestal. The assembly forming the stator of the machine has intake passages *B* and delivery passages *C*. The rotor keyed on the shaft is formed with cylindrical slots *D*, three in number, which carry the correspondingly shaped ends of the blades *E*. As more than 180 deg. of the surface of the blade ends is enclosed within the slot, the blades are prevented from being withdrawn. Cut-out portions in the surface of the rotor to receive the blades are provided, as shown in the case of the lower blade *F*. When operating as a pump or compressor, the rotor moves in the direction shown by the outer arrow, so that the curved blades force out the fluid to be pumped towards the outlet pipe *C*, the blades being received within the rotor as shown in the drawing. When, on the other hand, the machine described is to be used

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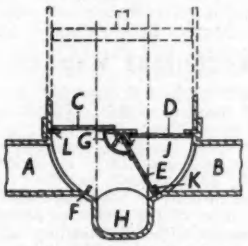
as a motor, the blades rotate in the direction shown by the inner arrow, the admission of fluid under pressure or of explosive charges taking place on the concave side of the blades. Modified designs are also shown in the specification.—*August* 20, 1952.

677,980. April 10, 1951.—VALVES FOR DOUBLE-ACTING RECIPROCATING PUMPS, Arnold Charles Littlewood, Shirleymoor Cottage, Hillside Lane, Corfe Mullen, Wimborne, Dorset.

The drawings show a cross section of the valve housing assembly with a portion of the pump cylinder. When the piston travels in an upward direction, a suction and discharge of liquid takes place simultaneously through the suction pipe *A* and discharge pipe *B*, this action lifting valves *C* and *D*, whilst valve *E* moves over to seat *F* fixed to valve *C* by a bracket *G*. These movements allow a clear passage for liquid through the valve chamber into the bottom pump chamber and from pump upper chamber through passage *H* and discharge chamber *J*. Immediately the piston starts to travel in a downward direction the three valves reverse their movements. Valve *D* is forced over to seat *K*, opening a clear passage for discharge from the lower pump chamber through valve chamber *J*, and so out through pipe *B*. Valve *C* is forced over to seat *L* taking with it valve *E* to seat *K*, which movements leave a clear passage for the suction of liquid through pipe *A*, the valve chambers and along passage *H* into pump upper chamber. The valve carrying frame, which also forms the valve seats, is held in position between the valve housing and the cylinder and may be removed from the valve housing when it is detached from the cylinder.—*August* 27, 1952.



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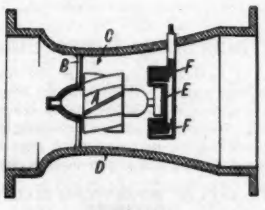
MEASURING INSTRUMENTS

678,135. March 14, 1951.—ROTARY WATER METER, Electricity Meter Manufacturing Company Pty., Ltd., Joynton Avenue, Waterloo, New South Wales, Australia.

As illustrated by the drawing, the rotor is a vane assembly *A* on a shaft in a spider cage *B*, mounted in the throat *C* of a venturi tube *D*. The shaft has an armature magnet *E* on the back end in current



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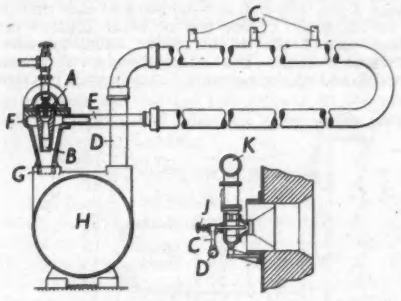
generating relationship with field coils *F* set in a sealed water-proof housing of such material that the flux will flow between the parts notwithstanding that the normal air gap is occluded by part of the water-proof housing. Current generated by the rotor is transmitted to and actuates a recording mechanism.

A rotor shaft with a radial magnetic coupling driving through a water sealed housing a spindle geared to a recording mechanism is also shown in the specification.—*August* 27, 1952.

BURNERS AND SPRAYERS

678,231. February 8, 1950.—MEANS FOR SUPPLYING OIL TO BURNERS, Joseph Samuel Lowe, Salmon Street, Preston, Lancashire.

According to the invention, oil is mechanically atomised and mixed with air in a nozzle arrangement, and the mixture is delivered under pressure to a service pipe feeding two or more burners where secondary air is supplied and combustion takes place, the surplus mixture from the pipe being returned to the oil and air mixing apparatus for admixture with



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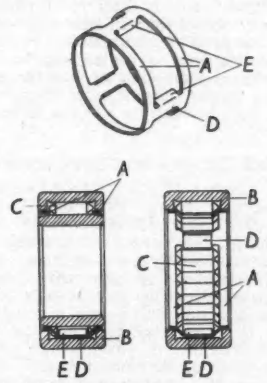
the new oil and air. As shown in the drawing, oil is supplied through a top valve and air enters around the oil inlet pipe, being controlled by a regulating disc *A*. The oil and air mix in a nozzle *B*. Mixture already supplied to burners from branches *C* on a service pipe *D* and not used by the burners, returns through a pipe *E* and enters tangentially into a conical chamber *F*, from which it passes after mixing with the oil-air mixture from the nozzle *B* to the inlet *G* of a compressor *H*. This compressor delivers the mixture under pressure through the pipe *D* and its branches leading to individual burners. Each burner has a fuel valve *J* and is supplied with secondary air by a pipe *K*, as shown in the drawing. A modified arrangement for use at higher pressures is also shown in the specification. In each case, the oil is atomised and mixed with air and with oil-air mixture from the burner return pipe in the nozzle arrangement, and further mixing is effected in the compressor. If desired, the oil may be supplied to the mixing device in the required quantities by means of a float chamber.—*August* 27, 1952.

BEARINGS AND SUPPORTS

678,249. August 21, 1950.—NEEDLE ROLLER BEARINGS, Duerkoppwerke Aktiengesellschaft, Nikolaus-Duerkoppstrasse, Bielefeld, Germany.

The invention provides a needle bearing comprising a race for the needle rollers and a one-piece cage, of sheet metal, for retaining the needle rollers in the



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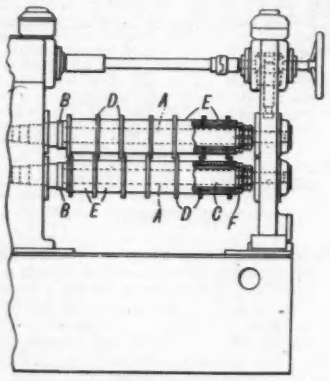
race. Two possible methods of construction of a bearing running ring according to the invention to form the outer part of the bearing, and the inner part of the bearing are shown. In all the views like parts are denoted by the same letter. Two peripheral end strips *A* of a bearing ring *B* in which is formed the running space for needles *C* engage over the points or tips of the needles, securing them against dropping out of the bearing. The peripheral end strips *A* are connected by bridges *D* which are depressed towards the interior of the running space, and the edges of which are flanged. In the drawing three such bridges are provided, but a greater number may be

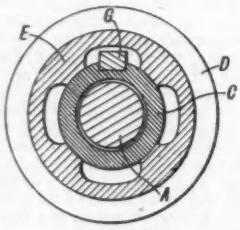
employed. The flanges *E* subdivide the running space into several parts, and act as guide surfaces for the needles *C* pressing against them, thereby preventing them from assuming staggered positions. The manufacture of bearing rings according to the invention is also described in the specification.—*August* 27, 1952.

TOOLS AND WORKSHOP APPLIANCES

678,707. April 28, 1951.—METAL CUTTING MACHINES, Joshua Bigwood and Son, Ltd., Wednesfield Road, Wolverhampton. (*Inventor: John Burley Picton.*)

In the construction illustrated in the top view, the machine has two parallel-spaced cutting elements, each including a shaft *A*, mounted in bearings, in parallel pillars. Both the shafts are driven and rotate in opposite directions. Each shaft is provided with a flange *B* near one end, and mounted on each shaft is a driving arbor *C*, one end of which engages the flange and is retained in contact there by nuts. Mounted on each arbor is an assembly of cutting discs *D* and spacer elements *E*, retained in position





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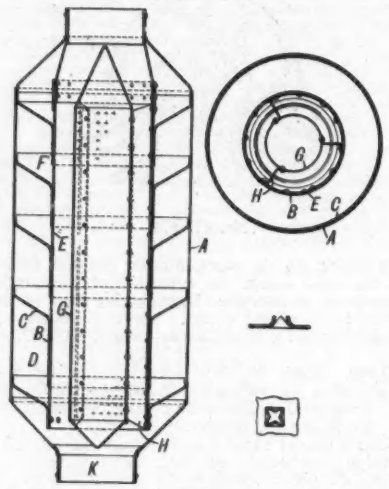
by nuts *F*. The arbor is provided with a key *G*, extending along the greater part of its length, and each of the cutting discs has a single keyway which engages the key. As shown in the lower view, each of the spacing elements *E* is provided with four key clearance gaps, equally spaced around the axis. In between each two gaps are centering portions, which engage the periphery of the arbor. The gaps in the spacing elements enable them to be placed on the arbor in any one of four different positions around the axis, thus permitting an assembly of slitting discs and spacer elements to be built up in which the thicker sides of some discs or elements are placed against the thinner sides of other discs or elements when the pitch between the slits has to be varied.—*September* 3, 1952.

INTERNAL COMBUSTION ENGINES

678,344. October 12, 1950.—EXHAUST SILENCERS, Vokes, Ltd., Henley Park, Guildford, Surrey. (*Inventor: Charles Mathias Streete.*)

The silencer illustrated in the drawings has a cylindrical outer casing *A* and an inner tube for the flow of gas constituted by cylindrical extensions *B* of baffles *C*, which divide the annular space between the casing and inner tube into a series of resonant sound chambers *D*. The inner tube is reinforced by a perforated metal tube *E*, which extends substantially the whole length of the inner tube and is riveted to the extensions *B*. Annular apertures *F* between the ends of the extensions and the adjacent baffles, spaced to register with the peaks of sound waves generated by a blower, give access to the resonant chambers *D* through the perforations of the tube. A cylindrical member *G* of perforated metal, but having imperforate conical end caps is centrally disposed along the axis of the inner tube and is held in position by riveted webs *H*. The member *G* may be empty, as shown, or filled with sound-absorbent material to form an aperiodic absorber or alternatively it may be subdivided along its length into a number of chambers whose length is chosen to resonate to selected frequency bands. The inlet to the silencer is at the top and the outlet is at *K*. The pulsating flow of gas entering is directed by the end cap into the annular channel defined between the member *G* and the inner tube. The flow is thus caused to pass in close proximity to the apertures *F*, giving improved efficiency in the silencing effect of the spaced slot and resonant sound chamber arrangement. At the same time, the member *G* acts as an additional sound absorber and masks the direct



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flow of sound from inlet to outlet. The gas contained in the member *G* becomes sluggish in its movement, an effect which is enhanced by the form of its perforations, so that it functions as an aperiodic absorbing medium. In some cases further resonant chambers may be provided in the member *G*, in which case these will act to damp out selected frequencies.—*September* 3, 1952.

Technical Reports

Fuel Research Technical Paper No. 56 : *The Preparation of Standard Sand.* D.S.I.R. London : H.M. Stationery Office. Price 1s.—The suitability of coals for many industrial purposes, e.g. in the carbonisation and gasification industries and for steam-raising, often depends on their caking properties. One method for assessing these properties is a modification of the Gray-Campredon test for the determination of the agglutinating value of coal, described in British Standard 705 : 1936. According to this test the agglutinating value of a given coal is defined as the maximum ratio of sand to coal in a mixture which, on heating under given conditions, yields a coherent coke of specified strength. The sand to be used for this test is either standard sand prepared and supplied by the Fuel Research Station, or any other sand that has been proved to give the same results. Since it is considered likely that the test will continue to be widely used in the future, details have been published in this report of the preparation of the standard sand at the Fuel Research Station, with drawings of the plant used.

Launches and Trial Trips

NOSSI BE, passenger and cargo liner ; built by the Ateliers et Chantiers de la Seine Maritime, Le Trait, for the Nouvelle Cie Havraise Peninsulaire ; length between perpendiculars 445ft, breadth moulded 60ft, depth to upper deck 37ft 5in, loaded draught 25ft 11in, deadweight 10,000 tons maximum, gross tonnage 8000 ; twenty-seven passengers, five holds, ten 10-ton derricks, two 5-ton derricks, and one 50-ton derrick ; Burmeister and Wain two-stroke, single-acting, diesel engine, eight cylinders, 740mm diameter by 1420mm stroke, 7000 b.h.p. at 125 r.p.m., service speed 15 knots ; one 260kW shaft-driven generator, two 160kW and one 120kW diesel generators. Trial, August.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

Mon., Sept. 29th.—BOURNEMOUTH BRANCH : Grand Hotel, Firvale Road, Bournemouth, "General Tariff Problems," H. E. White, 8.15 p.m.
Wed., Oct. 1st.—N. LONDON BRANCH : Three Jolly Butchers Hotel, Wood Green, N.22, "Public Address Systems," 8.15 p.m.
Thurs., Oct. 2nd.—S. LONDON BRANCH : Cafe Royal, North End, Croydon, "A Concrete Proposition," 8 p.m.
Fri., Oct. 3rd.—LIVERPOOL BRANCH : Liverpool Engineering Society, 9, The Temple, Dale Street, Liverpool, 9, "Television," B. P. Atkinson, 7.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Thurs., Oct. 2nd.—SCOTTISH SECTION : Department of Natural Philosophy, The University, Edinburgh, "Recent Developments in Television," H. McGhee, 7 p.m.
Wed., Oct. 8th.—LONDON SECTION : London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, annual general meeting, presidential address, W. E. Miller, 6.30 p.m.——N.E. SECTION : Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle, "Germanium Crystal Valves, Their Characteristics and Application," B. R. Bettridge, 6 p.m.

CHEMICAL SOCIETY

Wed., Oct. 1st.—BRISTOL SECTION : Premier Hall, Stroud, "Synthetic Fibres," B. T. Ridge, 7.15 p.m.
Thurs., Oct. 2nd.—BRISTOL SECTION : Chemistry Department, The University, Bristol, "Some Metallurgical Problems Imposed by Stratosphere Flight," P. L. Teed, 7 p.m.

ELECTRIC RAILWAY SOCIETY

Sat., Oct. 4th.—Fred Tallant Hall, 153, Drummond Street, London, N.W.1, "The Manx Electric and Snaefell Mountain Railways," J. H. Meredith, 3 p.m.

ILLUMINATING ENGINEERING SOCIETY

Mon., Sept. 29th.—LEICESTER CENTRE : E. Midlands Electricity Board, Charles Street, Leicester, "Horticultural Lighting," J. J. French, 6.30 p.m.
Tues., Sept. 30th.—CARDIFF CENTRE : S. Wales Electricity Board, Cardiff, Chairman's Address, A. J. Dalton, 5.45 p.m.
Wed., Oct. 1st.—EDINBURGH CENTRE : Lighting and Cleansing Department, 357, High Street, Edinburgh, "Lighting for Inspection," H. E Bellchambers, 7 p.m.——NEWCASTLE CENTRE : Minor Durant Hall, Oxford Street, Newcastle on Tyne, 1, Chairman's Address, G. Kingsley-Lark, 6.15 p.m.——SWANSEA GROUP : Minor Hall, Y.M.C.A., Swansea, Chairman's Address, G. J. Higgs, 6 p.m.
Thurs., Oct. 2nd.—GLASGOW CENTRE : Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2, "Lighting for Inspection," H. E. Bellchambers, 6.30 p.m.——NOTTINGHAM CENTRE : E. Midlands Electricity Board, Smithy Row, Nottingham, Chairman's Address, P. L. Ross, 6 p.m.——BRADFORD GROUP : Yorkshire Electricity Board, 45–53, Sunbridge Road, Bradford, "Textile Lighting," A. G. Smith, 7.30 p.m.——EXETER GROUP : Providence Hall, Northernhay Street, Exeter, "Lighting for the Prevention of Industrial Accidents," E. W. Murray, 7 p.m.
Fri., Oct. 3rd.—BATH AND BRISTOL CENTRE : S.W. Electricity Board, Old Bridge, Bath, "Lighting for the Prevention of Industrial Accidents," E. W. Murray, 7 p.m.——BIRMINGHAM CENTRE : "Regent House," St. Philip's Place, Colmore Row, Birmingham, Chairman's Address, E. H. Norgrove, 6 p.m.——HUDDERSFIELD GROUP : Electricity Showroom, Market Street, Huddersfield, "Some Aspects of Department Store Lighting," A. W. Jervis, 7.15 p.m.

INCORPORATED PLANT ENGINEERS

To-day, Sept. 26th.—BIRMINGHAM BRANCH : Imperial Hotel, Temple Street, Birmingham, "Modern Factory Lighting," F. Jamieson, 7.30 p.m.
Wed., Oct. 1st.—SOUTHAMPTON BRANCH : Polygon Hotel, Southampton, "Materials Handling and National Recovery," John R. Sharp, 7.30 p.m.
Tues., Oct. 7th.—LONDON BRANCH : Royal Society of Arts, John Adam Street, Adelphi, W.C.2. "Fire Protection in Factories and Works," G. W. Underdown, 7 p.m.——S. WALES BRANCH : S. Wales Institute of Engineers, Park Place, Cardiff, "Plant Inspection as an Aid to Maintenance," 7.15 p.m.

INDUSTRIAL WELFARE SOCIETY

To-day, Sept. 26th, to Monday, Sept. 29th.—Grand Hotel, Grange-Over-Sands, Lancashire, Week-end Conference, "What Should the Foreman Do ?"

INSTITUTE OF ECONOMIC ENGINEERING

To-day, Sept. 26th.—Radiant House, Bold Street, Liverpool, "Methods Time Measurement," B. Davis, 7.30 p.m.
Sun., Sept. 28th.—Midland Hotel, Manchester, "The Basic Principles of Lubrication—the Inside Story," Lecture and Film, 2.30 p.m.
Sat., Oct. 4th.—The Christian Institute, 70, Bothwell Street, Glasgow, "Methods," T. J. Haynes, 10.30 a.m.

INSTITUTE OF FUEL

Tues. and Wed., Oct. 28th and 29th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, Conference, "A Special Study of Ash and Clinker in Industry."

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Wed., Oct. 1st.—LONDON BRANCH : Royal Society of Arts, John Adam Street, Adelphi, W.C.2, Seventh Annual General Meeting, 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS

To-day, Sept. 26th.—YORKSHIRE ASSOCIATION : Royal Victoria Station Hotel, Sheffield, Chairman's Address, R. H. Evans, 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

Tues., Oct. 7th.—AUTOMOBILE DIVISION : Storey's Gate, St. James's Park, Westminster, London, S.W.1, Annual General Meeting, Address by the Chairman, 5.30 p.m.

INSTITUTION OF NAVAL ARCHITECTS

To-day, Sept. 26th, to Thurs., Oct. 2nd.—Autumn Meeting in Italy.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

Thurs., Oct. 2nd.—Conference Room, 4th Floor, Waterloo Bridge House, London, S.E.1, Vice-Chairman's Address, "Some Aspects of Local Line Utilisation," 5 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Wed., Oct. 1st.—Wolverhampton and Staffordshire Technical College, Sir Alfred Herbert Paper, "The Development of Engineering Metrology," F. H. Rolt, 7.15 p.m.

INTERNATIONAL MACHINE TOOL EXHIBITION

To-day, Sept. 26th to Sat. Oct. 4th.—Olympia, London.

IRON AND STEEL INSTITUTE

Tues. to Thursday, Oct. 7th to 9th.—Special Meeting in Swansea.

NATIONAL SMOKE ABATEMENT SOCIETY

To-day, Sept. 26th.—Portsmouth, Nineteenth Annual Conference.

ROYAL AERONAUTICAL SOCIETY

Thurs., Oct. 2nd.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, Eighth British Commonwealth and Empire Lecture, "Maintaining Airworthiness in Operation," R. E. Hardingham, 6 p.m.